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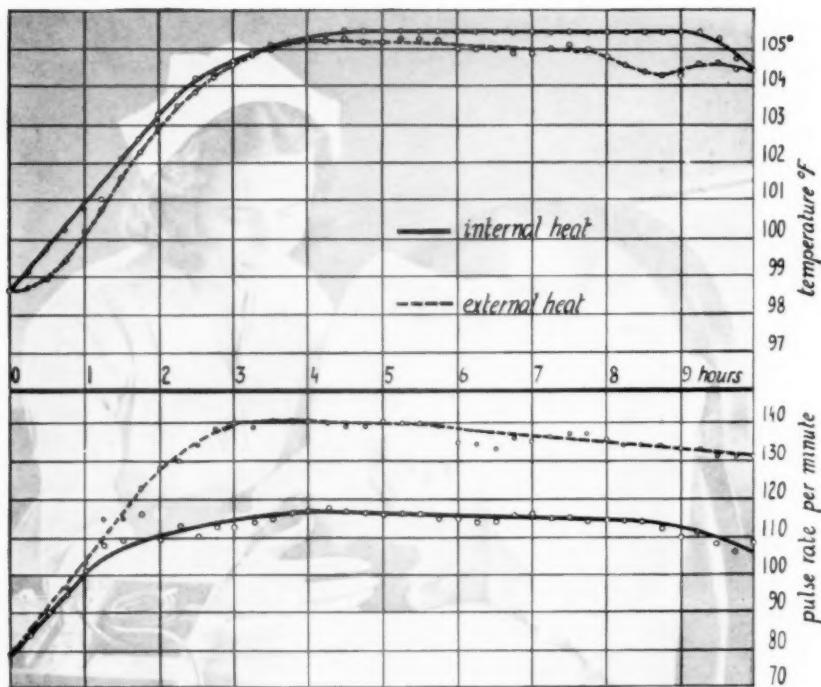
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No. 11



Effect of external and internal heat on the pulse rate at comparable rectal temperatures. From *Physiology of Hyperpyrexia* (S. L. Osborne), Dissertation for the Doctorate, Northwestern University, 1940.

FEVER THERAPY WITH MINIMAL INCREASED PULSE RATE

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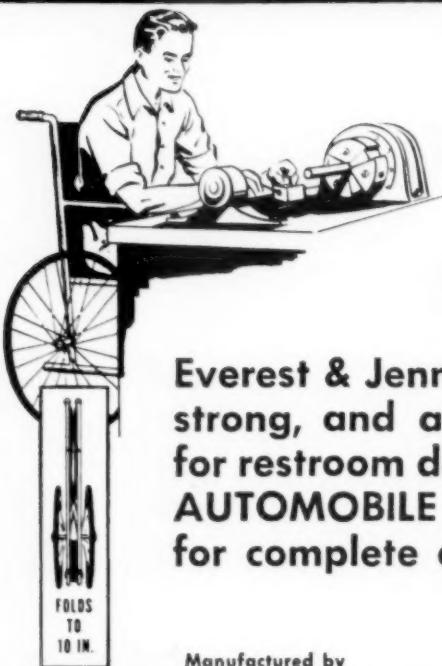
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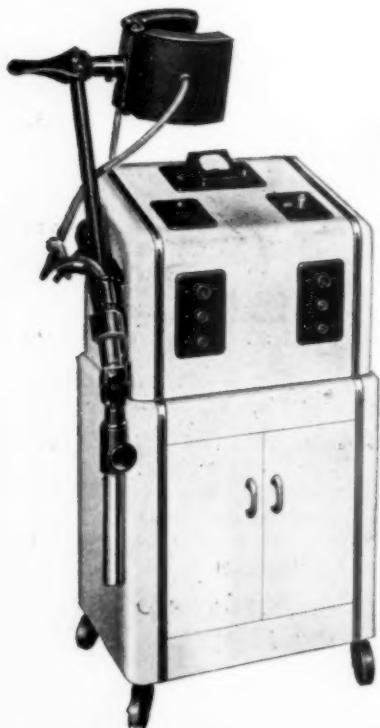
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KENNY TREATMENT COMBINED WITH NEUROTRIPSY IN CARE OF POLIOMYELITIS *

J. WAYNE McFARLAND, M.D.

Instructor in Therapeutics, College of Medical Evangelists
LOS ANGELES

LIEUTENANT COMMANDER HARVEY E. BILLIG, JR. (MC), U. S. N. R.

Assistant Professor of Orthopedics, College of Medical Evangelists
LOS ANGELES

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Associate Professor of Orthopedics, College of Medical Evangelists
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and

CLARENCE W. DAIL, M.D.

Assistant Professor of Therapeutics, College of Medical Evangelists
LOMA LINDA, CALIF.

In 1941 Cole and Knapp¹ gave their preliminary report on the treatment of infantile paralysis by the method of Sister Elizabeth Kenny. Since then this method has been widely used and much discussed. In 1943 Billig and van Harreveld² reported their findings on reinnervation of paretic muscles. Their work has been confirmed and their method is being applied on a larger scale in the treatment of residual paresis due to poliomyelitis.

At the White Memorial Hospital, Los Angeles, nerve crushing, or, as it is better termed, neurotripsy, is being combined with the Kenny method in the treatment of poliomyelitis. This report is a preliminary study of results obtained thus far. These two methods complement one another—the Kenny treatment for the acute stage of poliomyelitis and neurotripsy for cases in which the return of muscle power is not satisfactory. We believe that this is a valuable combination in the rehabilitation of the patient stricken with infantile paralysis.

It is not the purpose of this report to review the Kenny technic, since this has been done in several books and papers.³ The following is a brief résumé of results obtained by the use of the Kenny method at the Los Angeles County General Hospital and the outpatient clinics set up for follow-up care.

In this hospital there have been approximately 900 cases of poliomyelitis since July 1942, when the Kenny method was instituted. In every case there has been muscle "spasm" irrespective of paresis. Of the total, a series of 280 cases which could be adequately followed has been reported.⁴ There were various degrees of paresis as well as paralysis in 153 cases, as shown in the accom-

* Read at the Twenty-third Annual Session of the American Congress of Physical Therapy, Cleveland, Sept. 8, 1944.

1. Cole, W. H., and Knapp, M. E.: The Kenny Treatment of Infantile Paralysis, A Preliminary Report, J. A. M. A. **116**:2577 (June 7) 1941.

2. Billig, H. E., Jr., and van Harreveld, A. A New Aspect of Muscle Reinnervation, U. S. Nav. Bull. **41**:410 (March) 1943.

3. Pohl, J. F., and Kenny, E.: The Kenny Concept of Infantile Paralysis and Its Treatment, Minneapolis, Bruce Publishing Company, 1943. Cole, W. H.; Pohl, J. F., and Knapp, M. E.: The Kenny Method of Treatment for Infantile Paralysis, Arch. Phys. Therapy **23**:399 (July) 1942. Daly, Mary M. I.; Greenbaum, Jerome; Reilly, E. T.; Weiss, A. M., and Stimpson, P. M.: The Early Treatment of Poliomyelitis with an Evaluation of the Sister Kenny Treatment, J. A. M. A. **118**:1433 (April 25) 1942.

4. McFarland, J. Wayne: Kenny Treatment in Poliomyelitis: An Evaluation, California & West. Med. **61**:76 (Aug.) 1944.

Summary of Results in 153 Cases of Poliomyelitis with Initial Paralysis*.

Degree of Original Involvement	No. of Cases	Zero or Poor		Fair		Final Results		Excellent		Normal	
		No.	%	No.	%	No.	%	No.	%	No.	%
Extremely severe	38	8	21	11	29	10	26	7	19	2	5
Severe	60	—	—	2	3	11	18	19	32	28	47
Moderately severe	24	—	—	—	—	2	9	8	33	14	58
Slight	31	—	—	—	—	—	—	3	10	28	90
Total	153	8	5	13	9	23	15	37	24	72	47
		—14%*		—15%*		—71%*					
Function		Braces plus crutches		Crutches only		No support at all					

* Table adapted from McCarroll, H. R., and Crego, C. H.: *J. Bone & Joint Surg.* 23:851, 1941.

† These groups include cases in which there was comparable involvement of upper extremities.

† In all of these cases there was some degree of weakness, and the original involvement was graded as follows:

Extremely severe: Extremities with complete paralysis; severe bulbar symptoms; respirator cases.

Severe: Extremities in which the muscles were graded poor, trace and zero.

Moderately severe: Extremities in which the muscles were graded fair and below.

Slight: Extremities in which the muscles were graded fair and above, with only slight weakness.

The final functional recovery is given in detail in the text.

panying table. These cases are divided as to their final functional recovery as follows:

1. Normal — no paralysis; no residual weakness, or so slight as to be inconsequential; all muscles graded good or normal.
2. Excellent — no braces, crutches or canes; muscle weakness present but usefulness of extremities not limited.
3. Good — no braces, but crutches or canes needed; muscle weakness present, but bracing not required.
4. Fair — braces or other type of support required; function limited by contractures or only a partial return of muscle power in an extremity severely involved at the onset.
5. Zero or poor — function nil; slight or no return of power.

It will be noted that in this series of 153 cases, in all of which there was some degree of muscle weakness at the onset, the result in only 14 per cent remained in the fair to zero class. That is, the muscle function was so poor that braces or some type of support was required for the patient to carry on any activity. In 109 cases, or 71 per cent the result was classified as excellent or normal, with functional recovery; that is, no braces or support of any type was required. In 15 per cent, the patient, though not requiring braces, did use crutches or canes for weakened extremities. Neurotripsy was used in a number of these cases in which there was partial but incomplete return of muscle power.

Many observers have felt that there is little if any increase in muscle strength after the first year following the acute attack. Carroll⁵ in a study of 1,500 cases of infantile paralysis showed that approximately two thirds of the increase of muscle power was obtained during the first six to eight months after the onset of the disease. Because of this, we decided to use neurotripsy in some relatively early cases.

The rationale of neurotripsy is the fact that in regrowth after nerve interruption there is an increased branching.⁶ Langley and Anderson⁷ were among the pioneers in research on nerve growth and branching. Knowledge of this subject has recently been enlarged by Gutmann, Guttman, Medawar and Young⁸ Kilvington,⁹ by employing histologic and physiologic methods in animals, showed

5. Carroll, Robert L.: Rate and Amount of Improvement in Muscle Strength Following Infantile Paralysis, *Physiotherapy Rev.* 22:243 (Sept.-Oct.) 1942.

6. Greenman, M. J.: Studies on the Regeneration of the Peroneal Nerve of the Albino Rat: Number and Sectional Areas of Fibers; Area Relation of Axis to Sheath, *J. Comp. Neurol.* 23:479, 1913. Nageotte, J.: Sheaths of the Peripheral Nerves: Nerve Degeneration and Regeneration, in Penfield, W.; Cytology and Cellular Pathology of the Nervous System, New York, Paul B. Hoeber, Inc., 1932, vol. 1, sect. 5, p. 215.

7. Langley, J. N., and Anderson, H. K.: *J. Physiol.*, 29, III, 1902. Quoted by Watrous, W. G.: Axon Branching After Nerve Regeneration, *Proc. Soc. Exper. Biol. & Med.* 44:541 (June) 1940.

8. Gutmann, E.; Guttman, L.; Medawar, P. B., and Young, J. Z.: The Rate of Regeneration of Nerve, *J. Exper. Biol.* 19:14 (May) 1942.

9. Kilvington, B.: An Investigation on the Regeneration of Nerves with a View to the Surgical Treatment of Certain Paralyses, *Brit. M. J.* 1:935 (April 29) 1905.

that in regenerating nerves there is branching, and he suggested its use for reinnervation of paretic muscles in infantile paralysis. Apparently, however, he never applied these principles in the human. Feiss¹⁰ in 1911 attempted to "fuse" one nerve with another in a patient suffering from poliomyelitis, with results indicating improved function. Dogliotti in 1935¹¹ reported some improvement in muscle power after nerve interruption in a patient with paretic muscles.

With the perfection of a new technic, which seemed to offer better results than had earlier attempts at reinnervating paretic muscles, Billig and van Harreveld² reported an increase in muscle strength in experimental animals as well as in patients with poliomyelitis. The patients treated were those with residual paresis of many years' standing.

It seemed possible that if the procedure was used earlier, at about six to twelve months after onset, more muscle tissue might be saved by prevention of atrophy and fibrosis through hastening the return of muscle power. In the series herein reported neurotripsy was used (1) in 25 selected cases while the Kenny treatment was being given after the acute stage and (2) also in combination with the Kenny treatment, in 49 selected cases in which there was long-standing residual paresis.

Procedure

Neurotripsy is performed with the patient under general or spinal anesthesia. The objective is to break as many of the branches of the remaining live motor nerve axons as possible. The technic is to knead through the muscle vigorously and deeply with a blunt instrument (fig. 1). The muscle is covered thoroughly throughout its entire extent. An attempt is made to spread the muscle apart in as many places as possible. This produces avulsion-interruption of the axon branches so as to provide the maximal opportunity for their increased branching to muscle fibers in regrowth. The large arteries and nerves are avoided. The number of muscles treated at any one time depends on the age and general condition of the patient.

If neurotripsy is to be done before or soon after the first year of the disease, one must be particularly cautious in the use of anesthesia. This is especially true if there have been bulbar symptoms or respiratory difficulties at the onset, or if the involvement has been extensive.

Two operators usually work at the same time with two assistants holding the extremities. The average time required for an entire extremity is thirty minutes. It is important that the entire muscle be treated with multiple separations, so that as many widely spaced terminal motor nerve axon branches as possible will be interrupted. A thorough procedure is one in which not an area of muscle has been missed and the part feels pulpy.

The most extensive neurotripsy performed at one operation included the back muscles, shoulder girdle and one arm and both lower extremities. One would anticipate the development of shock after such extensive trauma to muscles and nerves unless it was remembered that major circulatory impairment is a necessary etiologic factor in such shock. Further study is contemplated on this most interesting problem arising out of neurotripsy.

The patient leaves the hospital one or two days after the operation. He may then be up and about and is encouraged to use the limb as much as possible. Alternate hot and cold baths are commenced at this time; warm to hot water is used for one to two minutes and cold to ice-cold water for thirty to forty-five seconds.

10. Feiss, H. D.: Recent Experimental Work on the "Fusion" of Nerves and its Practical Bearing on Infantile Paralysis. Report of a Case of Infantile Paralysis Treated by this Method. Boston M. & S. J. 164:667 (May 11) 1911.

11. Dogliotti, A. M.: Etudes expérimentales et première application clinique d'une nouvelle opération destinée à augmenter et à équilibrer la fonction neuro-musculaire dans la paralysie partielle des nerfs. J. de chir. 45:30 (Jan.) 1935.

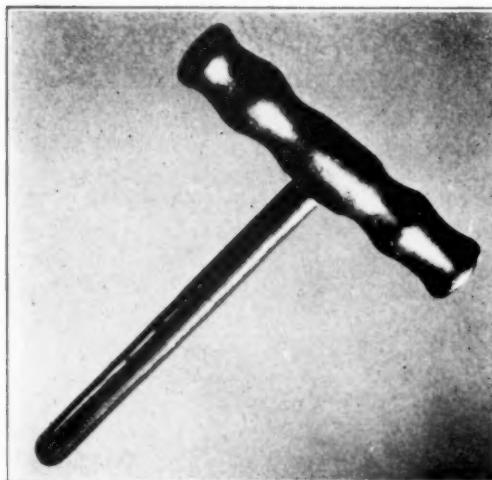


Fig. 1. — Instrument used for kneading the muscles in neurotripsy.

There have been no serious complications. However, tenderness, ecchymosis, edema and induration usually occur. These sequelae subside with contrast baths, heat, massage and passive movement.

It is common to find a great deal of residual muscle and fascial contracture in old cases in which the Kenny treatment was not given. Much of this can be relieved by the use of hot packs, hot partial baths, contrast baths and conservative fascial stretching. In these cases there are commonly found "incoordination" and "substitution," which are benefited by application of the Kenny principles of reeducation. Only when the patient has a good range of motion and has learned to use correctly the muscle power that is present can the maximal benefit be expected from neurotripsy.

Prior to, as well as after operation, the patient's muscles are graded so that any change in muscle strength may be recorded. Lovett's¹² grading system is used. This system employs gravity as well as joint range as a standard and is probably the most popular classification. For more accurate evaluation plus and minus grades are also used. There are therefore the following one-third steps: Zero, trace, trace plus, poor minus, poor, poor plus, fair minus, fair, fair plus, good minus, good, good plus and normal.

For many reasons it has become apparent that clinical muscle grading of individual muscles has not given an acceptable measurement of power in such muscles. The single grades recorded are expected to represent both power and extent of motion over the various degrees of the arc of motion. This is obviously impossible. Neither does the grading take into account increasing power within a limited arc of extent of motion, as frequently found in paretic muscles. Nor does this means of assignment of power to a particular muscle take into account the interrelation of power of the various muscles producing an individual joint motion.¹³ We are well aware of these faults in clinical muscle grading. Nevertheless, muscle grading as used for this study is the best system as

12. Lovett, R. W.: Fatigue and Exercise in the Treatment of Infantile Paralysis, *J. A. M. A.* **69**:168 (July 21) 1917.

13. Steindler, A.: Mechanics of Normal and Pathological Locomotion in Man, Springfield, Ill., Charles C. Thomas, 1935, chap. 9, p. 100. Carroll.⁵

yet devised. For future study plans are being formulated to evaluate muscle strength by direct measurement of muscle force.

In figure 2 are tabulated the effects of neurotripsy on the muscles which produce motion in the hip, knee, elbow and shoulder joints. These muscle groups were chosen because grading can be done more accurately on them than on the muscles which move the smaller joints. Results are indicated in terms of percentage of muscles treated which showed improvement in power. The upper curve, consisting of ninety-nine muscle groups, depicts the results in cases in which the onset of poliomyelitis had occurred more than two years prior to neurotripsy. After the operation the patients were treated according to the Kenny method. On the average those muscles which improved showed an increase in power of approximately two thirds of a step. For example, this would mean an increase in power from fair to good minus. The average increase in power of the ninety-nine muscle groups treated and tested was 0.77 one-third step.

The lower curve of figure 2 represents the results obtained in cases in which the patient was treated by the Kenny method from the onset. Neurotripsy was performed from six to seventeen months after onset. One should note

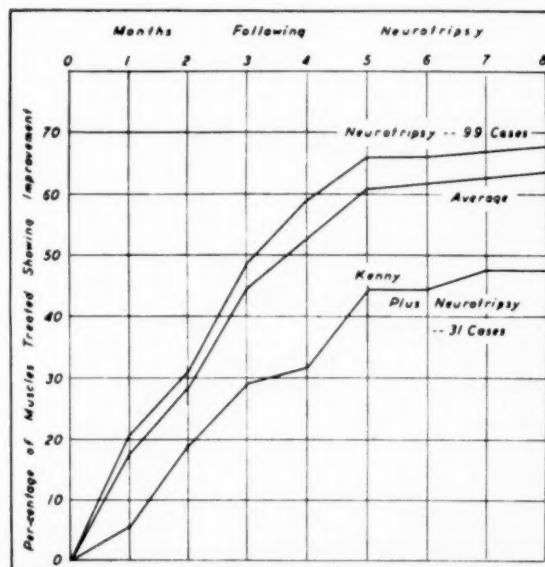


Fig. 2. — Month by month improvement of muscle strength after neurotripsy (130 muscle groups).

that the results are comparable to those obtained in the other series. In these, as well as in the cases in which neurotripsy was first used, the muscles which showed improvement showed an increase of approximately two thirds of a step. Thirty-one muscle groups were treated and graded. In these the average improvement amounted to 0.68 one-third step, which is practically the same as in the other series.

In the cases from which these curves are compiled the patients came in regularly for eight months or more after the operation for both muscle grading and treatment. It will be seen that there is leveling off of the curves in both the cases in which the Kenny treatment was not given at the onset and in those in which it was. The fact that improvement leveled off at about five months

after operation gives confirmatory evidence of the clinical effectiveness of this treatment.

As indicated by the graphs, increase in strength is not obtained in all the muscles treated. Muscles graded zero most frequently fail to show any increase in muscle power. The maximal improvement in muscle grade in this series was one and one-third steps. As an example, this would be equivalent to a change in muscle power from a poor to a fair plus grade.

Some of the results not shown in the graphs have been a rather consistent story of improved circulation in a limb that has been cold for a number of years. An increase in muscle size, with disappearance of atrophy, is a frequent result. The age of the patient or the length of time since the onset of paresis have proved no handicap to improvement in muscle power. Patients have found that they can stand or walk longer before tiring and that cramps are less frequent. The increase in muscle power is definite and though sometimes small may make possible the clearing of the steps in climbing or may prevent a hip shrug. It often tips the scale of muscle power just enough to enable the patient to go without a brace.

Summary

The treatment of poliomyelitis by a combination of the Kenny method and neurotripsy has been presented. The Kenny treatment has given consistently good results in the active stage of poliomyelitis in the cases studied. Neurotripsy has been found to be effective in the reinnervation of paretic muscles. Improvement in muscle strength occurred in over one-half of one hundred and thirty muscle groups studied. Although this report is preliminary to further study, the results are encouraging.

Note: Discussions of this paper will appear in a future issue of the ARCHIVES, along with the discussion of other papers presented and discussed at the same time.



ULTRAVIOLET BLOOD IRRADIATION THERAPY IN ACUTE POLIOMYELITIS

Preliminary Report on 58 Consecutive Cases *

GEORGE MILEY, M.D., D.Sc. (MED.)

PHILADELPHIA

This is a preliminary report on the results obtained with the Knott technic of ultraviolet blood irradiation therapy used in addition to the Kenny treatment in 58 cases of acute poliomyelitis.

The Knott technic has been described by several workers, notably Knott and Hancock,¹ Rebbeck,² Barrett³ and Miley.⁴ This technic consists of the withdrawal and citration of a predetermined amount of the patient's blood, followed immediately by passage of the citrated blood through a Knott hemo-irradiator, a precision machine which automatically exposes the citrated blood to high intensity ultraviolet rays safely and efficiently, and returns the irradiated citrated blood to the venous circulation of the patient.

As a result of our study during that part of the 1943 Los Angeles poliomyelitis epidemic which occurred between October 18 and December 6, we made the following clinical observations:

1. The Knott technic of ultraviolet blood irradiation, which is a general systemic type of therapy designed to raise the patient's resistance against infectious agents and their toxins, does not interfere in any way with the Kenny treatment when used in conjunction with the latter in the treatment of poliomyelitis in the acute stage.

2. The Kenny treatment, in turn, does not interfere in any way with the Knott technic of ultraviolet blood irradiation.

3. Of the 58 consecutive unselected cases of acute poliomyelitis in which the Knott technic was used in addition to the Kenny treatment, 11 were of the bulbospinal type. In 7 of these the disease was of a severe, fulminating nature, and in 1 death occurred; in 4 cases it was of a mild non-toxic type. The remaining 47 cases were of the spinal type. In 6 of these there were both severe toxic symptoms and an apparent progression of muscle weakness and spasm; in 5 cases severe toxic symptoms alone were present. In

This work was aided by grants from the Hahnemann Medical College and Hospital, and the Los Angeles Chapter of the National Foundation for Infantile Paralysis.

* From the Blood Irradiation Clinic, Hahnemann Medical College and Hospital of Philadelphia.

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these 11 cases, in all of which profound toxemia was observed, there was complete subsidence of the toxic symptoms, including a drop to normal of the elevated temperature within forty-eight hours after blood irradiation, and no further progression of the disease was noted.

4. There occurred a return to normal of the swallowing reflex after ultraviolet blood irradiation therapy in 7 consecutive cases. This took place within twenty-four hours of irradiation in 6 cases and within forty-eight hours in 1 case.

5. In all cases, twenty-four to forty-eight hours after ultraviolet blood irradiation therapy there occurred a complete subsidence of toxic symptoms, i. e. nausea, vomiting, fever, mental confusion and general malaise, regardless of the number of days which had elapsed between the onset of the disease and the time of blood irradiation. (We well recognize that in the natural course of poliomyelitis there is a period of rapid subsidence of toxic symptoms which might explain the results here noted, but the fact that the changes occurred in each case within twenty-four to forty-eight hours after blood irradiation is suggestive that this aspect of the disease may have been influenced).

6. No evaluation of any possible effects of the combined therapy on the residual paralysis or weakness of various muscle groups is possible at this time, as such an evaluation would require a much longer period of study, plus observation of a much larger series of cases.

Statistical Data

The essential details of our study are presented in the accompanying table. The cases have been divided into two major groups, with minor classifications, as follows:

Group I: Bulbospinal type.

- A. Severe toxic type.
- B. Mild nontoxic type.

Group II: Spinal type.

- A. Extremely toxic type, with apparent progression of muscle weakness and spasm.
- B. Toxic type, but no apparent progression.
- C. Mild type, with few or no toxic symptoms.

Thirty-six of the 58 cases belong to the third classification of group II; that is, they were mild cases of the spinal type of poliomyelitis with few or no toxic manifestations. As the only significant result that could be obtained in these cases was the disappearance of muscle spasm and weakness it is obviously impossible to comment on them at the present time. Further study over a long period is required for a proper evaluation. It can be said, however, that in none of these cases was any progression of the disease noted, and that all the patients were able to leave the hospital at the end of a two-week quarantine period.

An analysis of the table shows that of 7 patients critically ill with bulbospinal poliomyelitis 1 died, and 6, critically ill spinal cases who had shown apparent progression of muscle weakness and spasm, had no further progression of the disease. Thus 1 death occurred among 13 critically ill persons during the acute stage.

In cases 4, 5, 6, 8 and 9 the ability to swallow was absent at the time of blood irradiation but returned to normal within twenty-four hours of irradiation. In case 5 the swallowing reflex disappeared again sixteen days later; twenty-four hours after a second blood irradiation it once again returned to normal. In case 10 the swallowing reflex returned within forty-eight hours of blood irradiation. Thus of 7 consecutive cases in which the swallowing reflex was absent prior to blood irradiation, there occurred a

*Summary of Cases**Group I. — Bulbospinal Type**A. Severe Toxic Type —*

Case No.	Patient's Initials	Sex	Age (Yr.)	Condition at Time of Ultraviolet Blood Irradiation	Days from Onset to Irradiation	No. of Irradiations	Results
1	D. C.	M	11	Progressive respiratory failure, polioencephalitis; patient apparently moribund	3	3	Improved for 24 hr. after first irradiation, then lapsed into coma; a second irradiation was given 48 hr. after first; the lethargic and toxic symptoms began to subside 72 hr. later and had disappeared 96 hr. later; patient has been out of respirator for the last 4 wk.
2	M. N.	F	18	Progressive respiratory failure, polioencephalitis; patient apparently moribund	8	1	Patient died 62 hr. after the only irradiation
3	C. R.	M	13	Progressive respiratory failure	1	2	No toxic symptoms 48 hr. after first irradiation; patient out of respirator part time
4	H. F.	M	17	Patient unable to swallow for two days; nausea, vomiting	4	1	No toxic symptoms and patient able to swallow in 24 hr.; no further progression of disease process; patient discharged in 14 days in good condition
5	T. H.	F	23	Progressive respiratory failure; patient apparently moribund, 7 mo. pregnant, unable to swallow	4	2	No toxic symptoms after 24 hr.; patient able to swallow in 24 hr.; in respirator full time; relapse 4 wk. later, with cyanosis, cachexia which disappeared 24 hr. after a third blood irradiation; a normal infant delivered at term
6	B. A.	M	16	Patient unable to swallow; respiratory embarrassment, extreme irritability	5	1	No respiratory embarrassment or toxic symptoms 24 hr. after irradiation, and patient able to swallow
7	K. C.	F	23	Severe relapse of former respirator patient who had been out of respirator for over two wk.; respiratory embarrassment, anorexia, moderate toxemia, pallor, cachexia present	54	1	No respiratory embarrassment or toxic symptoms present 24 hr. after irradiation; no signs of cachexia 5 days later

B. Mild Nontoxic Type —

8	B. W.	M	9	Condition good, but patient unable to swallow for previous 2 wk.	6	1	Patient able to swallow within 24 hr.
9	D. K.	F	23	Anorexia, mild cachexia, nasal voice tone; patient unable to swallow	22	1	Patient systemically improved and able to swallow within 24 hr.; nasal voice tone unchanged
10	K. K.	F	8	Difficulty in swallowing, nasal voice tone	12	1	Patient able to swallow in 48 hr.; no change in nasal voice tone
11	L. W.	M	4	Patient improving rapidly; spinal symptoms only	14	1	Spontaneous improvement continued

Group II. — Spinal Type

A. Extremely Toxic Type, with Apparent Progression of Muscle Weakness and Spasm —

Case No.	Patient's Initials	Sex, Age (Yr.)	Condition at Time of Ultraviolet Blood Irradiation	Days from Onset to Irradiation	No. of Irradiations	Results
12	R. B.	M 15	Nausea, vomiting, irritability, inability to void, marked weakness of both legs and right arm; + + + neck, back and hamstring spasm	4	2	In first 24 hr. after one blood irradiation patient was still toxic, and respiratory difficulty appeared; this lasted only one hr.; 48 hr. later all toxic symptoms had disappeared, and no further progression was noted
13	R. R.	M 12	Rapid progression; + + + neck, back and hamstring spasm; some encephalitic manifestations	7	2	Toxic symptoms gone in 24 hr.; no further progression noted; recovery relatively rapid
14	L. T.	M 12	Rapid progression; + + + neck, back and hamstring spasm; weakness of both legs and right arm; twitching of face muscles; patient unable to void; some respiratory difficulty; encephalitic manifestations	6	2	Complete subsidence of all toxic symptoms in 48 hr., with no further progression noted
15	R. F.	M 15	Rapid progression; generalized hypersensitivity; + + + neck, back and hamstring spasm	9	1	Complete subsidence in 24 hr. of toxic symptoms; some further weakness in muscles already affected, but no spread to other muscle groups noted
16	R. M.	M 12	Rapid progression; + + + neck, back and hamstring spasm; marked weakness of all extremities; beginning respiratory difficulties	5	1	Complete subsidence of all toxic symptoms in 48 hr., with no further progression noted
17	P. S.	M 4	Rapid progression, with complete loss of function in left leg and partial loss in right within a few hours; very little toxemia	3	1	No further progression noted

B. Toxic Type, but No Apparent Progression —

18	R. J.	M 9	Severe toxemia; temperature 104 F.; + + + neck, + + back and hamstring spasm	10	1	Toxic symptoms gone in 48 hr.; temperature 98.6 F. in 72 hr.
19	A. B.	M 16	Severe toxemia; + + + neck, back and hamstring spasm	4	2	Subsidence of toxic symptoms 48 hr. after first irradiation
20	I. P.	M 12	Moderate toxemia; + + neck, + + back, hamstring spasm	4	1	Complete subsidence of toxic symptoms in 24 hr.
21	E. B.	M 14	Moderate toxemia; + + + back and hamstring spasm	1	1	Complete subsidence of toxic symptoms in 24 hr.
22	R. M.	F 7	Moderate toxemia; + + + back, neck and hamstring spasm	10	1	Complete subsidence of toxic symptoms in 24 hr.

return to normal of this reflex in 6 within twenty-four hours and in 1 within forty-eight hours after application of this therapy.

Clinical Observations

In addition to the clinical observations already mentioned, we noted several points which we felt were interesting and possibly instructive.

In 2 additional cases in which there were bulbospinal symptoms, it was impossible to gain consent for ultraviolet blood irradiation therapy. In each the patient died. Among the cases of bulbospinal poliomyelitis in which irradiation therapy was given, 1 patient out of 11 died, a mortality rate of 9 per cent, as compared with a rate of 35 per cent for similar cases in the same epidemic in which this therapy was not employed.

In the 4 surviving respirator patients there occurred at various intervals relapses characterized by general apathy, anorexia, cachexia, pallor and extreme fatigue. In each these symptoms disappeared rapidly after further application of ultraviolet blood irradiation therapy. The complete absence of deleterious effects was obvious.

Theoretical Considerations

The theoretical background for this work consists of extensive reports made over a period of many years by a large number of investigators in the field of ultraviolet chemistry plus recent observations made by several clinicians working independently with the Knott technic.

Comprehensive monographs, including in their scope the whole field of the physiologic biochemical effects of ultraviolet rays, have been written by Ellis, Wells and Heyrodt⁵ and Duggar.⁶ In these are cited numerous excellent reports on the bactericidal and the detoxifying effects of ultraviolet rays, which are shown to have had highly lethal effects on many pathogenic bacteria, including those responsible for infections of the acute pyogenic type, and to have had a definitely inactivating effect on the toxins elaborated by the same bacteria. Clinically, Knott and Hancock,¹ Rebbeck,² Barrett³ and Miley⁴ have shown that in cases of acute pyogenic infection, a disease process due to bacteria sensitive to ultraviolet rays, there occurred uniformly a marked bactericidal and detoxifying effect in the first twenty-four to forty-eight hours after the use of the Knott technic of ultraviolet blood irradiation.

Furthermore, ultraviolet rays have been demonstrated to have highly lethal effects on various viruses, including the poliomyelitis virus. Hodes, Webster and Lavin⁷ have shown that the rabies virus exposed to ultraviolet rays loses virulence yet retains considerable immunizing potency for mice. Morgan and Lavin⁸ have produced a noninfective immunizing antigen by ultraviolet irradiation of the virus of Eastern equine encephalomyelitis. Toomey was able to inactivate the virus of poliomyelitis with ultraviolet rays.⁹

After use of the Knott technic in cases of mumps¹ and primary atypical pneumonia,⁴ the former a definite virus infection and the latter a virus-like disease process, the toxic symptoms subsided within twenty-four to forty-eight hours.

Since disease processes due to bacteria sensitive to ultraviolet rays had

5. Ellis, C.; Wells, A. A., and Heyrodt, F. F.: *The Chemical Action of Ultraviolet Rays*, New York, Reinhold Publishing Corp., 1941.
6. Duggar, B. M.: *Biological Effects of Radiation*, New York, McGraw-Hill Book Co., Inc., 1936.
7. Hodes, H. L.; Webster, L. T., and Lavin, G. I.: *The Use of Ultraviolet Light in Preparing a Nonvirulent Antirabies Vaccine*, *J. Exper. Med.* 72:437 (Oct.) 1940.
8. Morgan, I. M., and Lavin, G. I.: *Immunizing Capacity of Eastern Equine Encephalomyelitis Inactivated by Ultraviolet Light*, *Proc. Soc. Exper. Biol.* 47:497 (June) 1941.
9. Toomey, J. A.: *Inactivation of Poliomyelitis Virus by Ultraviolet Irradiation*, *Am. J. Dis. Child.* 53:1490 (June) 1937.

responded favorably to ultraviolet blood irradiation therapy, it was felt that diseases due to viruses sensitive to these rays, specifically the poliomyelitis virus, might be favorably influenced by the same type of therapy.

Summary

A detailed report has been given of the results after use of the Knott technic of ultraviolet blood irradiation in addition to the Kenny treatment in 58 cases of acute poliomyelitis during that part of the 1943 Los Angeles epidemic which occurred between October 18 and December 6.

The ultraviolet blood irradiation therapy was attended by no harmful effects in this series of cases.

No contraindications to the combined use of ultraviolet blood irradiation and the Kenny treatment has appeared. On the contrary, a supplementary relationship has been apparent in the cases studied to date.

A complete subsidence of toxic symptoms in the first twenty-four to forty-eight hours after blood irradiation occurred consistently. (Again we wish to emphasize that we realize there is a period in the natural evolution of poliomyelitis during which a rapid subsidence of toxic symptoms may be expected, but the fact that such changes occurred routinely within twenty-four to forty-eight hours after blood irradiation suggests that this phase of poliomyelitis may have been influenced by this type of therapy).

Conclusion

After study of the clinical observations made in 58 consecutive cases of acute poliomyelitis in which the Knott technic of ultraviolet blood irradiation was used in addition to the Kenny treatment, it is our considered opinion that further extensive clinical studies of use of this technic in the treatment of acute poliomyelitis are warranted, in order that a more comprehensive evaluation may be obtained.



A COMPREHENSIVE REHABILITATION CENTER *

WALTER J. ZEITER, M.D.,

SHELBY GAMBLE, M.D.

Cleveland Clinic

and

BELL GREVE

Cleveland Rehabilitation Center

CLEVELAND, OHIO

Rehabilitation of the disabled is one of the foremost problems of the day. Because of the shortage of manpower every resource must be utilized to obtain sufficient help to meet pressing needs. Postwar reconstruction with the goal of better living standards depend for complete realization on the full use of the country's manpower, including the intelligent use of the handicapped.

It is the purpose of this paper to present the means of effecting rehabilitation and to describe a comprehensive rehabilitation center, breaking down the services necessary so that by modification to meet specific needs it may be used as a basis for organization.

Vocational rehabilitation, broadly defined, is the aiding of a disabled person to make the best physical and vocational adjustment of which he is capable.

Under the Federal Vocational Rehabilitation Act of 1930 as amended by Congress in 1943, the criteria of eligibility for rehabilitation services are (1) an established handicap, either physical or functional, and (2) a reasonable expectation of successful vocational rehabilitation. Successful vocational rehabilitation requires a study of the individual problem, cooperation of the patient and appropriate resources and services. The bill was amended in 1943 to apply to the functionally disabled and to provide funds for physical rehabilitation, which may include physical therapy, occupational therapy, speech therapy and artificial appliances or braces, in addition to medical and surgical care.

In order to extend these services to all persons, a rehabilitation center may be needed to supplement services existing in the community, particularly hospitals. The first step in organization is the appointment of a board of directors of persons interested in a rehabilitation program, such as industrialists, physicians and representatives from service clubs.

A medical advisory board is equally important to assume responsibility for medical policies and procedures of treatment. This should include specialists in the disabilities, such as an orthopedist, an industrial surgeon, a cardiologist, a phthisiologist, a psychiatrist, a physical therapy physician and an internist. To coordinate the function of a medical advisory board it is well for the chairman to serve as a member of the board of directors.

Financial support may be secured from fees charged private patients, the industrial commission, self-insured plants, insurance companies, the bureau of vocational rehabilitation, the board of county commissioners and services for crippled children. Additional money may be obtained from the sale of articles produced by patients, from grants for specific services or projects and from the Community Fund.

Comprehensive rehabilitation may be roughly divided into the following four steps:

1. Social case study and medical diagnosis.
2. Development of a plan for physical rehabilitation.

* Read at the Twenty-Third Annual Session of the American Congress of Physical Therapy, Cleveland, Ohio, Sept. 6, 1944.

3. Preparation of the patient for the selected occupational objective.
4. Placement of the patient in suitable employment.

Thorough case study and accurate diagnosis are essential as a basis for a rehabilitation program in which the total capacity of the patient is utilized. Training will depend on the patient's past training, education, attitudes toward school and training, previous employment, interests, attitude toward his disability and, finally, on the disability itself.

The physical capacity of the patient is of basic importance. A thorough medical examination, including a psychologic survey in the physical disability case as well as a psychiatric study in the neuropsychiatric case, is necessary for proper evaluation of the emotional stability of the patient in relation to the demands to be made of him in the process of rehabilitation. It is essential to have competent medical, surgical and psychiatric care in order to reduce or remedy the disability.

The objective of the rehabilitation program is to accomplish vocational rehabilitation leading to specific occupational adjustment based on the mental and physical capacities of the patient. Consideration must be given both to the available services and resources for rehabilitation and to the opportunities for employment in a chosen field. Under the Vocational Rehabilitation Bill financial assistance may include the services of a reliable training agency, books, tools, tuition and living expenses.

The final step in the rehabilitation program comprises placing the patient in a position consistent with his capacities and his preparation. This, of course, depends on opportunity for employment in his home community, for it has been well established that it is usually a grave error to place a patient too far away from his friends and accustomed surroundings.

The three essentials of organization of a vocational rehabilitation program are the following:

1. The service should be highly individualized and should be determined by the patient's total need.
2. Qualified specialists in medicine, surgery, psychiatry and psychology as well as medical social workers and specialists in education and occupational guidance should be available.
3. The responsibility for the disabled person should be concentrated in the hands of a single worker for efficiency and the development of the patient's confidence.

In a rehabilitation center the following services, which will be discussed in the order in which a patient might be studied and trained, are offered:

1. Medical social case work and individual supervision.
2. Medical, surgical and psychiatric consultation.
3. Physical medicine, including the following:
 - (a) Physical therapy.
 - (b) Occupational therapy.
 - (c) Speech therapy.
4. Psychologic and aptitude testing.
5. Vocational adjustment and training.

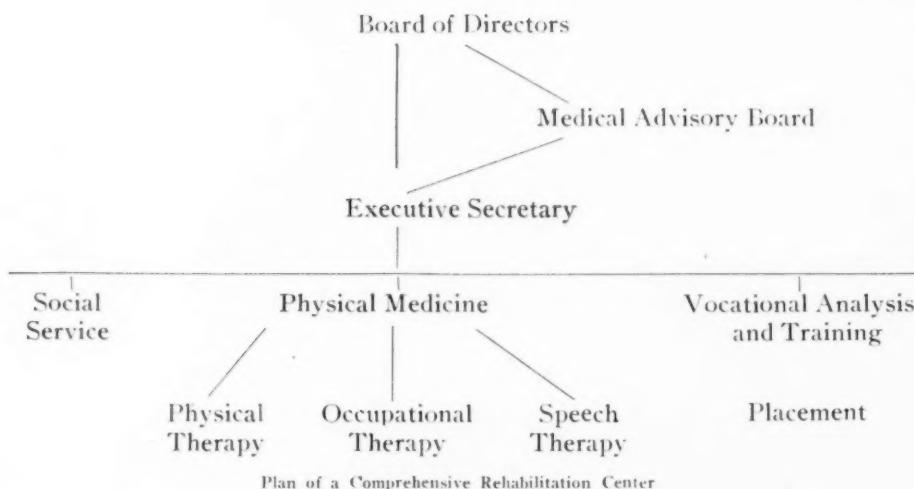
Medical Social Case Work

The objects of medical social case work are (1) to admit new patients to the center, (2) to handle the social, personal and economic problems which affect the patient's ability to take advantage of the available rehabilitation services and (3) to help each patient to obtain the maximum vocational adjustment. A new patient entering the rehabilitation center is interviewed by a social worker in the admitting department. If the patient has a prescription for treatment from a referring physician, the patient is registered, the fee is determined and the patient is interviewed to see whether services in addition to the prescribed treatment are indicated immediately or as a subsequent part of the pro-

gram. The medical history and information concerning previous treatment are supplied by the referring physician together with recommendations for the use of any of the services available at the center, such as home-bound service, vocational guidance and training, active treatment in physical, occupational or speech therapy, or the fitting of an appliance.

If the patient does not have a prescription from a referring physician, a complete history of his physical, social and economic status should be obtained. This survey consists of the following four steps: (1) medical and physical examination; (2) investigation of the social status, which includes the home, family and environment; (3) educational history, including school achievement and results of mental tests; and (4) record of previous employment. The patient is then referred to a private physician or clinic for diagnosis and recommended treatment.

After this information has been obtained, the social worker outlines a plan of services for the patient. The patient and the prescription are checked by the supervising physician. As the patient improves, new services may be added so that he is rehabilitated and readjusted to the maximum of his capabilities.



Physical Therapy

If the medical survey indicates that the patient needs physical therapy, or if a prescription has been received from a referring physician or clinic, these recommendations are reviewed by the consultant in the department of physical medicine. In a department of physical medicine in which "in and out" patients are treated, it is essential that the physician have information about the onset and course of the disability as well as previous treatment.

The patient is examined to determine the extent of disability and to confirm the indicated treatment. Frequently it is possible to supplement the treatment, or, in some instances, it may be necessary to curtail or prescribe a less strenuous program. In a broad program of rehabilitation the use of various basic physical agents is frequently necessary to bring about the desired result, and it may also be necessary from time to time to change the treatment to obtain satisfactory progress.

In a paper of this type it is impossible to discuss all the various physical agents that may be utilized, but a few may be enumerated:

Heat in various forms should be used for two basic purposes, production of local hyperemia and relaxation of the affected part.

Massage, which is essential and must be specifically prescribed, in our opinion, is often omitted from the treatment program when it may be of decided value.

Therapeutic exercise may be active or passive, with or without apparatus, and has a definite value in restoring diseased or injured tissues to as nearly normal function as possible.

Hydrotherapy may be used extensively to serve any of the basic principles listed.

Electricity in the form of low voltage currents is of particular value in the diagnosis and treatment of certain nerve lesions and also as a means of stimulating muscle.

Apparatus, such as stall bars, graduated stairs, rings and pulleys or the shoulder wheel, may be used in a well rounded program of therapy.

The physician should compare the patient's progress with the expected improvement and change the prescription when indicated. When a long range program has been outlined, the patient should be returned to the referring physician from time to time so that he also may observe the progress made.



Fig. 1. — Vocational rehabilitation.

In many instances a combination of physical and occupational therapy is more effective than the use of physical measures alone. When indicated, occupational therapy should be started at an early date.

Occupational Therapy

Occupational therapy is an essential part of any rehabilitation program and is treatment based on activities. Occupational therapy may be defined as any activity, mental or physical, prescribed by a physician to hasten recovery from a disease or injury. It is provided by a definite program in which some mental or physical activity is scientifically supervised by trained technicians for the purpose of overcoming functional disability, improving morale and reestablishing the patient's usefulness.

Occupational therapy may be divided into avocational and vocational programs, which may be further subdivided as follows:

1. *Functional occupational therapy* is a program of graded activity employed to restore articular and muscular function, to improve the general condition, to build up strength and physical endurance and to aid in mental rehabilitation. It is based on the theory that actual effort on the part of the patient to use the disabled part is necessary for the return of function.

2. *Diversional occupational therapy* comprises simple recreational activities designed to divert the patient's thoughts from himself and his disability and to arouse his interest, courage and confidence as well as to improve his morale and general physical well-being through active participation in useful activity.

3. *Prevocational occupational therapy* is work planned to prepare the patient either to return to his former job or for new vocational training.



Fig. 2. — Training in conditioned reflexes of industry.

As physical therapy and occupational therapy supplement each other, it is very important that they be coordinated in the rehabilitation program. Heat and massage prepare the part for active exercise. Preparatory physical therapy should be followed immediately by active exercise in occupational therapy, and the two departments should, therefore, be located close together and the schedules dovetailed. Both departments should be under medical supervision.

All tasks in occupational therapy should be simple, so that the patient does not spend too much time in learning them and so that the task may be easily analyzed by both the patient and the occupational therapist to determine whether the desired motion is being made. There should always be a specific goal to the task being performed, and it should not be justified on the grounds of making the patient happy or keeping him amused.

To accomplish the desired results treatments should be given often; three times a week is the minimum, and five or six times a week is preferred if the patient is to get the maximum benefit. The tasks must be carefully graded as to physical activity and should gradually be made more difficult, the aim being

to keep the task just one step ahead of the patient in his progress. Monotony must be avoided at all times, for this is detrimental to the program. The psychologic stimulation of a patient engaged in occupational therapy, through talking with other handicapped persons, seeing what others accomplish and seeing how he may improve, is a big boost to morale which cannot be achieved in any other way.

The equipment need not be elaborate. The essentials are a bicycle saw and lathe, floor looms and woodworking tools and games such as shuffleboard, floor dominoes and checkers. Wall painting and wall washing can be advantageously used with little cost. If the type of motion desired is explained, many patients intelligent enough to grasp the purpose of the task may get occupational therapy at home with periodic medical supervision.

Speech Therapy

In a rehabilitation center speech difficulties or defects are not infrequently observed and must have active treatment if full rehabilitation is to be obtained. Usually speech therapy centers are associated with universities and are equipped to handle simple as well as very difficult speech problems, which may involve the use of complicated and extensive mechanical equipment.



Fig. 3. — Pipe cutting conditioned reflexes.

A rehabilitation center should have a staff prepared to undertake work in the speech correction field, for the treatment of long term cases requiring other therapies and frequent medical and social consultation. Speech therapy procedures differ greatly with the various problems. It may be primarily auditory, visual or kinesthetic in approach. It may involve phonetic principles, application of physics of sound or exercises to improve muscular coordination or relaxation.

Vocational Adjustment Department

The vocational adjustment department of a rehabilitation center offers specialized services to the patient whose handicap, either mental or physical, makes it difficult for him to make an adequate vocational adjustment. Rehabilitation is based on a program of selected work activities and vocational training in combination with or supplemented by work tests, psychologic and aptitude tests and

vocational guidance and counseling. Every type of physical disability can be handled and the patient's assets and liabilities determined. It is of prime importance that instruction in the vocational training program be given by specialists who have had practical as well as teaching experience.

The program of work activity should be designed to meet the needs of (1) the patient who requires an increased tolerance to physical work, such as the cardiac or the tuberculous patient who needs medical supervision, nursing care and rest periods; (2) the patient who requires testing and observation for physical tolerance, aptitudes and work habits, and (3) the patient who needs training. Any of these patients may be assigned to other training facilities in the community to complete his training. During this period too much emphasis cannot be placed on employee relationships, good working habits, good workmanship and techniques of learning. Also during this time the patient who is not adjusting himself to his physical disability or has personality maladjustments may be observed and studied.



Fig. 4. — Training in the use of crutches.

It is absolutely necessary that the various services of the rehabilitation center work together, for creative rehabilitation is a combination of efforts of the various services and might be termed "teamwork." Of no small importance is the fact that the patient must be, or at least feel that he is, a part of the team working to accomplish the task before him.

Woodworking tools and machines and sewing are used primarily for testing the patient to determine his ability to use different tools and light machinery, his reaction to supervision and responsibility, his adaptability to new situations and to fellow workmen, his powers of judgment and his ability to exercise initiative. These are but a few of the personality traits and characteristics that may be observed in a workshop. In addition, the workmanship, mechanical ability, dexterity and coordination of the patient and his limitations in terms of physical tolerance and function may be observed.

Instruction may be given in various fields, which will vary with each center. Commercial courses, such as beginning and advanced typing and shorthand, be-

ginning bookkeeping, filing and ediphone and mimeograph operation may be easily adapted for women. For men, depending on the educational background, training and other factors, engineering drawing, such as geometric or mechanical drawing, tool design and shop mathematics may be utilized. Courses may be given in commercial drafting, shoe repair, printing, bookbinding and the use of tools and light machinery. Sheltered workshops may also be set up in which work is provided in woodworking, dressmaking, power machine sewing, furniture refinishing and factory assembly.

At all times the patient's need in relation to his rehabilitation plan as a whole must be kept in the foreground. An attempt should be made to meet each patient in his interests, hobbies, education and vocational aspirations to whatever extent is feasible. It is often possible to set up small individual projects such as printing, sign painting, leather work and clock repair, although the large shop is the basic activity. Placement after training may be handled through private agencies or, at present, through the United States Employment Service.

It cannot be stated too emphatically that disabled persons can be rehabilitated and trained for certain jobs, which they should be able to perform as well as a physically capable person. In fact certain jobs may be performed better by a "cripple," and placement in a job for reasons of charity or good will alone is one means of destroying an excellent rehabilitation program, not only for one individual but for the others.

Provision must be made for the patient who cannot be trained for a job in industry, and the need arises for a sheltered workshop or home industry program so that he may partially support himself. The activities that may be carried on in such a sheltered workshop have been enumerated. The success with which a sheltered shop functions depends mainly on the industrial conditions in the community.

There is no doubt that work with tolerant and understanding supervision is in itself of definite value in the treatment of the patient both mentally and physically. This is true particularly in the case of persons who present problems of unadaptability or negative personality, behavior or mental attitudes toward their disability and employment. Socialization through group contacts in a work program has great psychologic value for these patients.

Summary

We have presented what we believe are the services necessary in a rehabilitation center. The object of such a center is to provide services which are not readily available in the community hospitals and institutions. In order that a rehabilitation center may function efficiently, it is necessary to have a medical social service department, a department of physical medicine and a department of vocational guidance and training, as shown in the plan of a comprehensive rehabilitation center.



ARTIFICIAL FEVER-CHEMOTHERAPY *

II. Arterial Oxygen Saturation

R. M. CRAIG, PASSED ASSISTANT SURGEON (R) U. S. P. H. S.

G. X. SCHWEMLEIN, PASSED ASSISTANT SURGEON (R) U. S. P. H. S.

and

H. WORLEY KENDELL, SURGEON (R) U. S. P. H. S.

It is generally agreed that there is an increased demand for oxygen by the patient during physically induced fever. Anoxia will occur if adequate oxygen is not supplied. The amount of oxygen in the arterial blood can be measured and used as an indicator of adequate oxygen supply to the tissues. Cullen, Weir and Cook¹ have demonstrated that the arterial oxygen saturation of a patient undergoing physically induced fever is diminished. Hartman² has reported a lowered percentage oxygen saturation of the arterial blood in animals subjected to hyperpyrexia and declared some of the changes found at necropsy after deaths attributed to fever therapy to be due to lack of oxygen.

The major types of anoxia are³ anemic, stagnant, histotoxic and anoxic. The use of oxygen therapy may correct the condition of anoxic anoxia but is of limited value in the correction of other types.⁴ Anoxic anoxia is characterized by a low arterial oxygen tension. The oxygen-carrying capacity of the blood is normal, but the hemoglobin is not carrying the gas to the limit of its capacity. The most frequent cause of anoxic anoxia is a mechanical hindrance in the lungs which prevents the free diffusion of gases from the alveoli into the blood. Another cause is shallow breathing.⁵ One of the factors causing this type of anoxia is a lowered arterial oxygen saturation. It was decided, therefore, to determine whether a lowered arterial oxygen saturation was present in patients with early syphilis treated with fever-chemotherapy, and whether, if present, it could be corrected by the administration of oxygen. The routine employed for these patients consisted of six to eight hours of fever maintained at a level of 106.0 F. (rectal), with administration of 2 cc. of oil-insoluble bismuth and 1.76 mg. of mapharsen per kilogram of body weight.

The previously mentioned studies of Cullen, Weir and Cook² demonstrated that the oxygen saturation of arterial blood was influenced by the administration of oxygen. However, the analyses were "spot" analyses, done by chemical determination on samples of arterial blood secured by arterial

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From the Section on Fever-Chemotherapy, Chicago Intensive Treatment Center, Venereal Disease Control Program, Chicago Board of Health, in Cooperation with the United States Public Health Service.

1. Cullen, S. C.; Weir, E. F., and Cook, E.: The Rationale of Oxygen Therapy During Fever Therapy, *Anesthesiology* 3:123 (March) 1942.

2. Hartman, F. W.: Lesions of the Brain Following Fever Therapy, *J. A. M. A.* 109:2116 (Dec. 25) 1937.

3. Barcroft, J.: *Lancet* 2:485, 1920. Peters, J. P., and Van Slyke, D. D.: Quantitative Clinical Chemistry, Baltimore, Williams & Wilkins Co., 1932, vol. 1.

4. Boothby, W. M.: Oxygen Therapy, *J. A. M. A.* 90:2026 (Dec. 10) 1932.

5. Goodman, L., and Gilman, A.: The Pharmacological Basis of Therapeutics, New York, The Macmillan Co., 1941, p. 681.

punctures at various times during the administration of therapeutic fever. The study presented here utilized a physical method for the continuous measurement of the oxygen saturation of arterial blood.

Method

The oximeter⁶ is an instrument for the continuous measurement of percentage arterial oxygen saturation.⁷ It operates on the principle that oxyhemoglobin transmits more red light than does reduced hemoglobin and that by use of a lamp on the lateral side of the concha of the ear, a red color filter and a light-sensitive cell on the medial side, this change in transmission of red

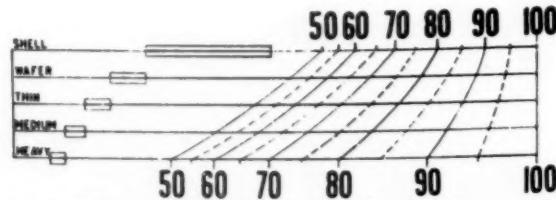


Fig. 1.—The scale of the galvanometer. (Courtesy Glasser, O., Editor, *Medical Physics*, Chicago, The Year Book Publishers, Inc., 1944, p. 900).

light can be measured and interpreted in terms of percentage saturation of hemoglobin with oxygen (fig. 1).

The instrument can be used with little or no discomfort to the patient and no interference with the technical application of therapeutic fever. The



Fig. 2.—The ear piece of the instrument. (Courtesy Glasser, O., Editor, *Medical Physics*, Chicago, The Year Book Publishers, Inc., 1944, p. 901).

accuracy is about 5 per cent in the upper half of its range (75 to 100 per cent arterial oxygen saturation) and about 8 per cent in the lower half

6. Dr. A. C. Ivy; Dr. F. S. Grodins, and Mr. W. L. Burkhardt, of the Department of Physiology, Northwestern University Medical School, gave valuable advice and guidance in the use of the oximeter.

7. Millikan, G. A.: Oximeter, and Instrument for Measuring Continuously the Oxygen Saturation of Arterial Blood in Man, Rev. Scient. Instruments, 13:434, 1942.

(50 to 75 per cent arterial oxygen saturation). The percentage oxygen saturation is read directly from a calibrated scale of a galvanometer which is influenced by the amount of light transmitted to the light-sensitive scale of the ear unit (fig. 2).

The mechanics of standardizing the instrument may be obtained from the instruction book which is furnished by the manufacturer.

Standardization is accomplished by having the patient breathe 100 per cent oxygen by means of a Boothby, Lovelace, Bulbulian oronasal mask for a period of five minutes and setting the galvanometer deflection at 100 per cent oxygen saturation at the end of this period. No further adjustments of the instrument are necessary during the period of observation.

After standardization of the patient is completed, the mask is removed and a nasal catheter is inserted into the nostril to the oropharyngeal junction.

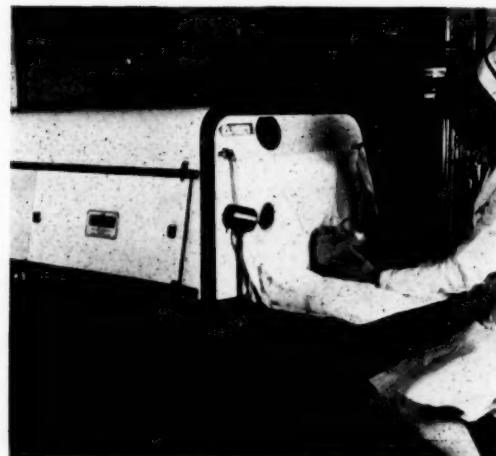


Fig. 3. — Nasal catheter connected with oxygen flow meter.

This remains in place throughout treatment and the flow of oxygen through the catheter is controlled by a float type of flow meter connected to a humidifier. This method of oxygen therapy is used routinely in the fever therapy department and is a satisfactory method for the continuous administration of oxygen both as to comfort of the patient and as to ease of operation (fig. 3). The amount of oxygen supplied to the patient can be increased or decreased by adjustment of the flow meter. All patients are routinely furnished oxygen at the rate of 5 to 8 liters per minute.

Results

Arterial oxygen saturation was determined in 10 patients while they were receiving fever-chemotherapy for early syphilis. Three other patients were observed for a short period, but the investigation was discontinued because the concha of the ear was too small to accommodate the ear piece of the instrument satisfactorily. These 3 patients are not included in this report.

Each of the 10 patients exhibited the same type of response to the withholding of oxygen therapy and to its restoration. Invariably, when oxygen was withheld there was a 2 to 10 per cent decrease in the arterial oxygen saturation. The decrease was within 2 per cent in the same subject when repeated deprivation of oxygen was employed. The restoration of oxygen caused a rise in the percentage of arterial oxygen saturation, and the value in each case returned to the previous level in from five to fifteen minutes.

The average, the maximum and the minimum percentages of arterial oxygen saturation were determined for this group of patients (fig. 4). The

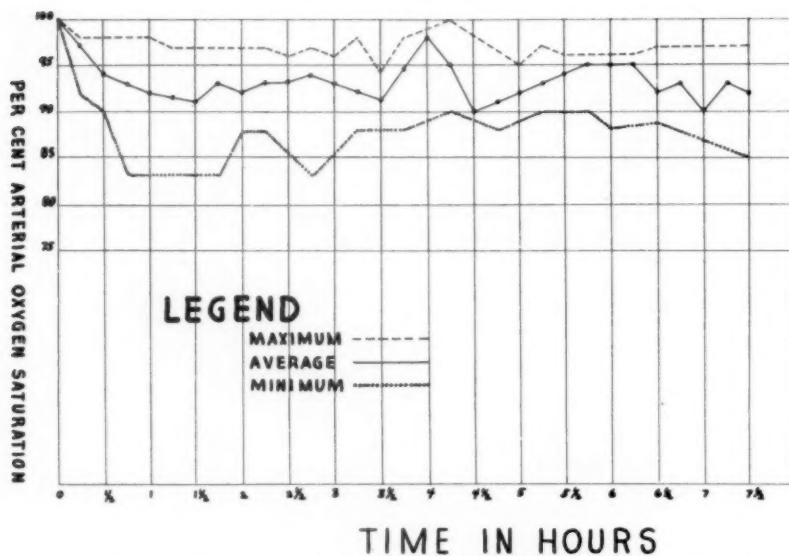


Fig. 4. — Average, maximum and minimum percentages of arterial oxygen saturation of the patients studied.

third patient studied had one reading of 100 per cent arterial oxygen saturation during the treatment. No other patient exhibited this finding. We believe this demonstrates that a 100 per cent arterial oxygen saturation cannot be maintained by means of a flow of oxygen of 5 to 8 liters per minute through a nasal catheter.

The lowest determinations were 83 per cent arterial oxygen saturation. These were all on the same patient, who was deprived of complementary oxygen for one and one-half hours from the beginning of treatment (fig. 5). The percentage of arterial oxygen saturation did not go below 83 at any time during this period, and that percentage may be accepted as the base line for that patient. The restoration of oxygen therapy produced the same type of response in this patient as in those who had not been deprived of complementary oxygen for such a long period. This was considered evidence that it was the administration of oxygen therapy, and that alone, which caused the increase in the percentage of arterial oxygen saturation.

An immediate decrease occurred each time oxygen was withheld, and

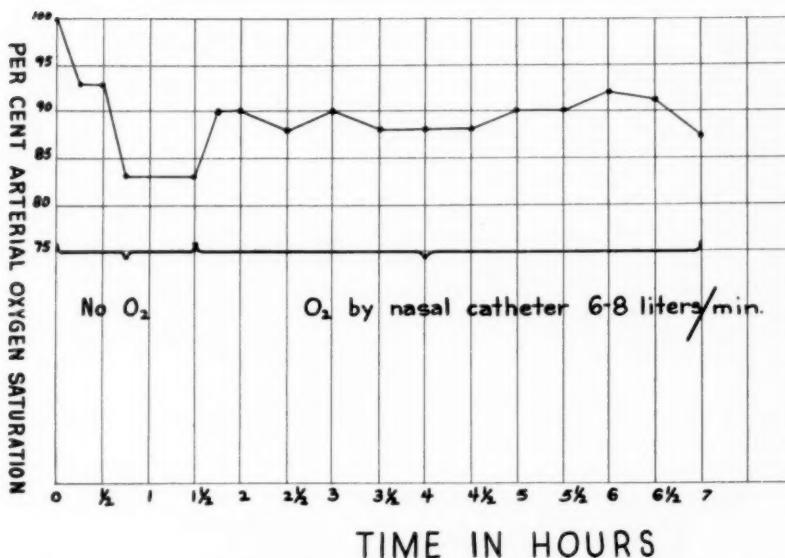


Fig. 5. — Complementary oxygen supplied one and one-half hours after the beginning of treatment.

the arterial oxygen saturation returned to its original level when oxygen was again supplied through a nasal catheter at the rate of 5 to 8 liters per minute. A Boothby, Lovelace, Bulbulian oronasal mask was used to supply 100 per cent oxygen after one period of deprivation, and the response was the same as with the nasal catheter (fig. 6).

The chemotherapeutic agents used during the session of fever, sedatives and mapharsen, had no influence on the percentage of arterial oxygen saturation.

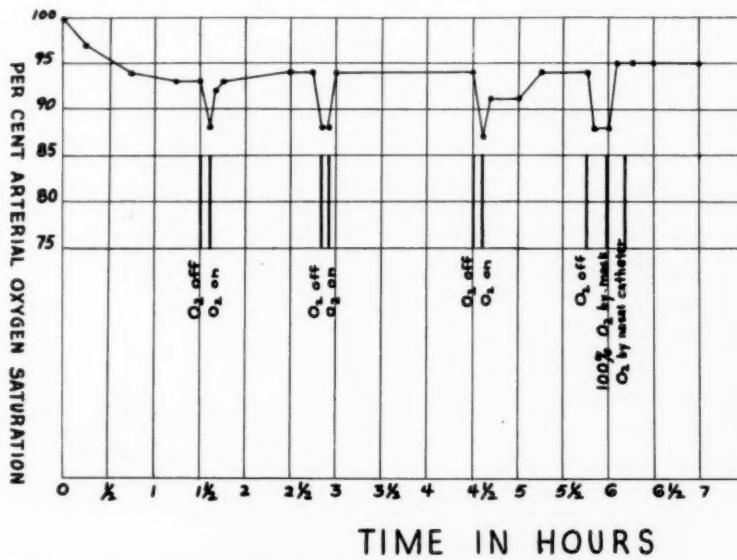


Fig. 6. — Response of arterial oxygen saturation to deprivation and supply of complementary oxygen.

The administration of more than 5 to 8 liters per minute of oxygen by nasal catheter after deprivation did not cause a more rapid rise in the percentage of arterial oxygen saturation or cause an increased value to be maintained.

Summary

The use of the oximeter as a method of measuring the percentage arterial oxygen saturation of 10 patients undergoing artificial fever-chemotherapy for early syphilis is described.

There was invariably a lowered percentage arterial oxygen saturation when complementary oxygen was not supplied.

The use of oxygen by nasal catheter with a rate of flow of 5 to 8 liters per minute is a satisfactory and efficient method of preventing or correcting the lowered percentage arterial oxygen saturation.

EDITOR'S NOTE: This is the second of a series of articles on artificial fever-chemotherapy to be published in the ARCHIVES. The first article in the series appeared in the October issue.

THE MAILING LIST

The mailing list of the ARCHIVES has been revised to meet the demands of the postal authorities who are asking that zones be included wherever they have been established to expedite delivery. If your mail address does not show a zone, and it should, you are requested to notify the central office of the Congress so that correction can be made. This is important if prompt delivery is to be made.

PHYSICAL BASIS OF AIR DISINFECTION BY ULTRAVIOLET ENERGY *

L. J. BUTTOLPH, Sc.D.

Nela Park Engineering Division, General Electric Company

CLEVELAND, OHIO

The bacteria-killing effect of ultraviolet energy and the practicality of the mercury arc as its source has been known for forty years. The most effective wavelength and the most efficient type of mercury arc have been known for only a few years. The bactericidal effectiveness of the 2,537A (angstrom) wavelength and the efficiency of its production in a low pressure mercury arc comprise one of the most remarkable coincidences in the bio-physical field.

Ultraviolet energy was early used to kill water-borne bacteria, and, since knowledge of the most effective wavelengths was lacking, every wavelength was used, from 1,800A to 3,800A. Only part of this spectrum has since been found effective.¹ Wavelengths completely reflected, completely transmitted or superficially absorbed have no photochemical or lethal effects. Only such wavelengths as penetrate micro-organisms and are absorbed in them can produce chemical changes and destruction. The result is a bactericidal effect curve somewhat similar in form to curves expressing the erythema (skin-reddening), photochemical and luminosity (visibility) effects of other wavelength ranges (fig. 1).

The bactericidal and erythema effect curves cover similar spectral ranges but have their maxima at different wavelengths, 2,650A and 2,950A, respectively.² Some of this difference is due to the absorption by ultraviolet rays of the cholesterol of the skin, which has a maximum at about 2,800A and accounts for the vitamin D value of this part of the sun's and the sun lamp's spectrum. While the 2,850A wavelength is both erythema and bactericidal, it is only about one quarter as effective as wavelength 2,950A for erythema or one quarter as effective as wavelength 2,650A for bacteria killing. This means that such intensities of 2,800 to 3,000A as are sometimes present in direct sunlight are of bactericidal value in time,³ but slow killing may be of limited practical value. Such intensities of 2,800A and shorter as are characteristic of the atmosphere a few miles above the earth's surface doubtless prevent bacterial life there.

With 2,650A energy, time, the amount depending on the intensity, is required for bacteria killing and sudden death becomes a relative matter. The term exposure is used for this product of intensity by time, as in photographic processes. For reasons related to ventilation theory, a 63.2 per cent killing, removal or decrease in concentration is a convenient unit of meas-

* Read at the Twenty-Third Annual Session of the American Congress of Physical Therapy, Cleveland, September 8, 1944.

1. Coblenz, W. W., and Fulton, H. R.: A Radiometric Investigation of the Germicidal Action of Ultraviolet Radiation, *Sci. Papers, Bureau Standards* **19**:641, 1924.

2. Gates, F. L.: A Study of the Bactericidal Action of Ultraviolet Light, *J. Gen. Physiol.* **13**:231, 249 (Nov. 20) 1929; **14**:31, 1930. Luckiesh, M.; Holladay, L. L., and Taylor, A. H.: Reaction of Untanned Human Skin, *J. Optic. Soc. America* **20**:423 (Aug.) 1930. Adams, E. O.; Barnes, B. T., and Forsyth, W. E.: Erythema Due to Ultraviolet Radiation **21**:207 (Apr.) 1931. Laurens, Henry: Physiological Effects of Radiant Energy, New York City, Chemical Catalog Co., 1933. Duggar, B. M.: Biological Effects of Radiation, New York City, McGraw-Hill, 1936. See papers of Brackett, F. S., p. 123; Daniels, F., p. 253; Smith, E. C., p. 889; Duggar, B. M., p. 1119.

3. Hollander, Alex.: Effect of Long Ultraviolet and Short Visible Radiation (3500-4900A) on *Escherichia Coli*, *J. Bact.* **46**:531 (Dec.) 1943. (See its references to earlier and related papers.) Buchbinder, L.; Salowey, M., and Phelps, E. B.: Survival Rates of Streptococci in the Presence of Natural Daylight and Sunlight and Artificial Illumination, *J. Bact.* **42**:353 (Sept.) 1941.

ure of these effects and has been called the *lethe*⁴ and the ultraviolet ray exposure necessary to produce a 63.2 per cent killing has been called the unit lethal exposure. A 63.2 per cent kill has been adopted as a unit, the *lethe*, because it is the percentage reduction in air contamination of any kind resulting from a dilution with a similar volume of fresh air. For example, if into a closed volume of 100 cubic feet of contaminated air 100 cubic feet of fresh air is introduced with continuous and perfect mixing, there will remain 36.8 per cent of the original contaminated air, the reciprocal of the base of

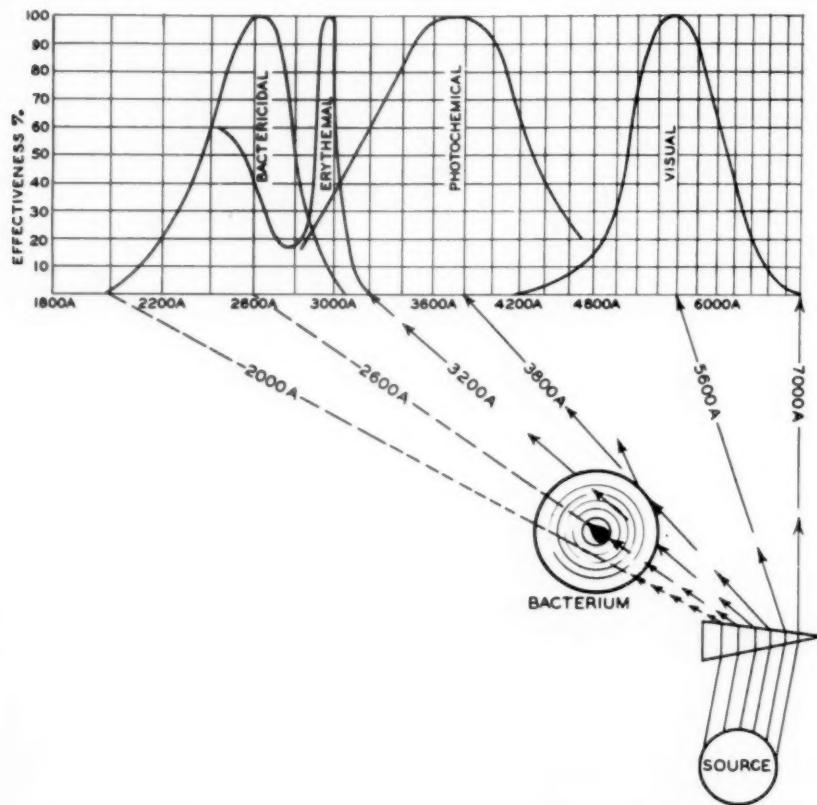


Fig. 1. — Relative visual and ultraviolet effect curves and a suggestion as to selective bactericidal effect at 2,650 Å.

natural logarithms, 2.718, in the usual mathematical analysis. Repetition of the process will leave 36.8 of the residue, or 13.5 per cent. When the reduction in bacteria is by ultraviolet irradiation it apparently makes little difference whether the exposure is to a high intensity for a short time or to a low intensity for a long time, except for intensities so low that the damage is repaired at a measurable rate. Although minutes and watts are convenient units for purposes of definition, it is of interest and essential for some purposes to know how the intensity used in defining the *lethe* is related to the total time required for practically complete killing, because there is evidence to indicate the need of intensities in air disinfection sufficient to produce practically complete killing in a few minutes. The numerical value of the lethal exposure, the product of intensity and time, differs for various classes of organisms, and in the case of the harmless *Bacillus coli*, commonly used as a test organism, by tenfold according to the humid-

4. Wells, W. F.: Bactericidal Irradiation of Air, *J. Franklin Institute* 229:347 (March) 1940. (See its references to earlier Wells papers.)

ity of its environment and, perhaps, the method of air sampling. There seems to be agreement on about 0.01 watt per square foot for one minute, or $0.01 \text{ watt min.}/\text{ft}^2$, as a tentative lethal exposure for *B. coli*, wet or air borne and acclimated to 100 per cent relative humidity.⁵ This means that 0.01 watt of 2,537A energy uniformly distributed over a square foot area covered with bacteria, or throughout a cubic foot of infected air, will kill 63.2 per cent of the bacteria in one minute; +63.2 per cent of the remaining

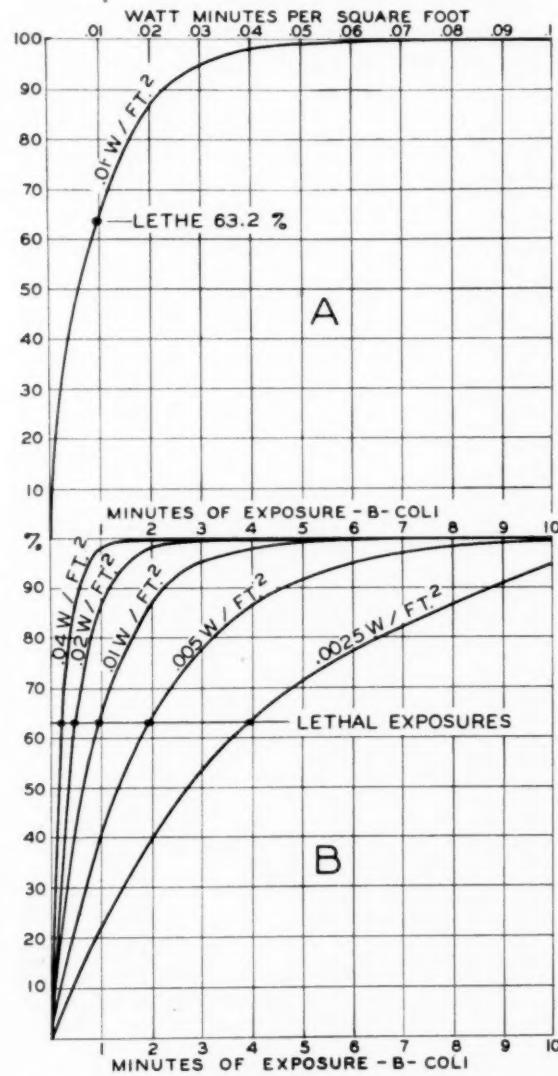


Fig. 2. — Time and intensity relationships and the unit of bactericidal effect.

36.8 per cent, or 86.5 per cent in two minutes; 95 per cent in three minutes; over 99 per cent in five minutes; 99.9 per cent in seven minutes, and 99.99 per cent in 9 to 10 minutes (fig. 2A). Thus a 99.99 per cent kill may be

5. Koller, L. R.: Bactericidal Effects of Ultraviolet Radiation Produced by Low Pressure Mercury Vapor Lamps, *J. Applied Physics* **9**:624 (Sept.) 1938. Whisler, B. A.: The Efficacy of Ultraviolet Light Sources in Killing Bacteria Suspended in Air, *Iowa State Col. J. Sc.* **14**:215 (Apr.) 1940. Luckiesh, M., and Holladay, L. L.: Tests and Data on Disinfection of Air with Germicidal Lamps, *General Electric Rev.* **45**:223 (Apr.) 1942. Rentschler, H. C.; Nagy, R., and Mouromseff, G.: Bactericidal Effect of Ultraviolet Radiation, *J. Bact.* **41**:745 (June 1941) and Bactericidal Action of Ultraviolet Radiation on Air-Borne Organisms, *J. Bact.* **44**:85 (July) 1942.

said to result from a tenfold lethal exposure, or from 10 lethes. Just as unit lethal exposure may be provided by a wide range of intensities and inverse times, a few of which are indicated in figure 2B, so practically complete killing, 99.99 per cent, may be produced by a wide range of intensities and inverse times. In practical work the time factor may be important.

Some conditions may demand the rapid lethal action of a high intensity, while others will permit only a low intensity and a slow lethal action

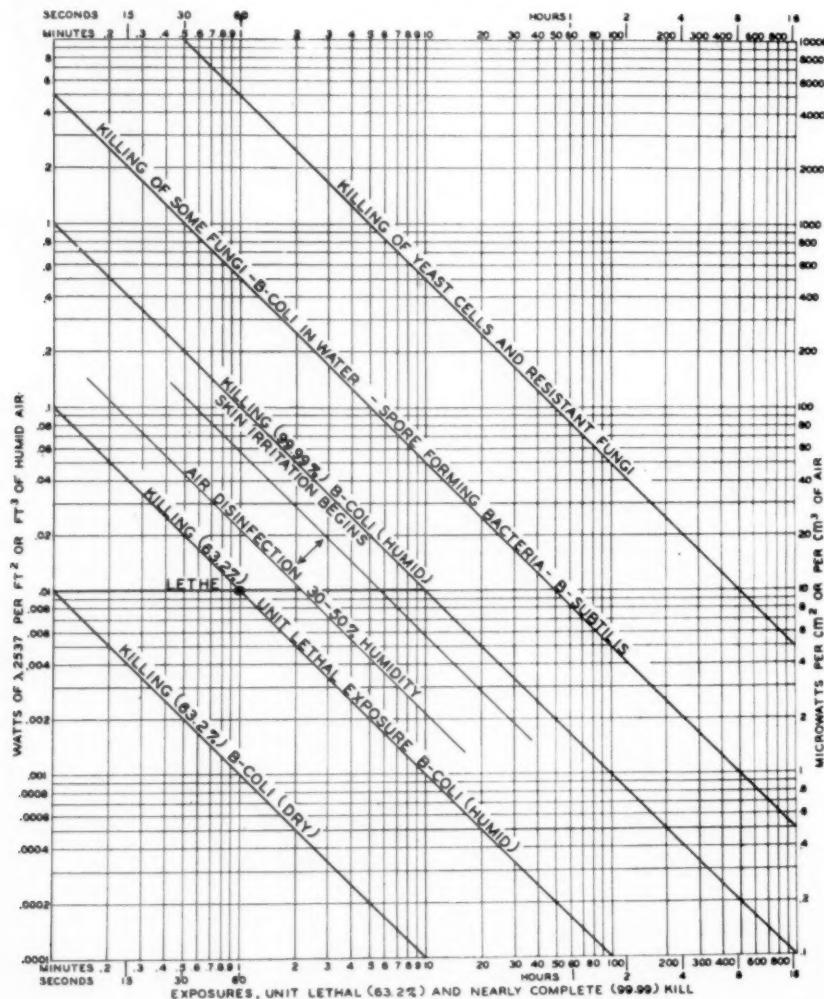


Fig. 3. — Exposures for unit and nearly complete killing of bacteria, yeast and fungi under various conditions.

will have to be accepted. It is for this reason that the Council on Physical Medicine of the American Medical Association has tentatively adopted a unit of germicidal intensity, G.U., ten times that producing a lethal exposure in one minute, or 0.1 watt/ft.² (100 microwatts/cm.²),⁶ which produces not a 63.2 per cent but a practically complete killing, over 99.99 per cent, in one minute. From the relationships shown in figure 2B come the inverse time and intensity lines for a practically complete killing of *B. coli* of figure 3, where it is shown, for example, that for a 99.99 per cent killing under adverse

6. Council on Physical Therapy, Acceptance of Ultraviolet Lamps for Disinfecting Purposes, J. A. M. A. 122:503 (June 19) 1943.

conditions in one hour about 0.002 watt/ft.² is needed; in ten minutes 0.01 watt/ft.²; in five minutes 0.02 watt/ft.²; in one minute 0.1 watt/ft.²; in ten seconds 0.6 watt/ft.²

Wells⁴ and Whisler⁵ found one-tenth these values to provide a lethal exposure on very dry air-borne *B. coli*, while Luckiesh and Holladay⁵ assigned values one-half these for *B. coli* at 35 per cent relative humidity and four or five times as great for *B. coli* in water.

Spore-forming bacteria and fungi are harder to kill than the ordinary bacteria, while yeast cells are still more resistant. As a first approximation, the values of the lethal exposures and of the total exposures for nearly complete killing may be increased by multiples of ten for each successive type of organism, as is indicated by figure 3.

It is an interesting fact that ultraviolet exposures effective for the complete killing of *B. coli* produce an erythema, or reddening, of sensitive skins and that there is eye irritation with about one third of that exposure, or 0.035 watt min./ft.². To illustrate the reciprocity relationship in the case of eye irritation, it may be said to result from exposures ranging from 2 watt sec./ft.² to 0.00055 watt hr./ft.². In practical terms this means some eye irritation in thirty seconds and some skin reddening in one and one-half minutes at about 3 feet from a bare 30 watt germicidal lamp. It is fortunate that this irritation, even when severe and painful, is responsive to treatment and disappears entirely in a day or two with no apparent permanent injury.

There is an important difference between the killing of bacteria on surfaces usually completely absorptive of 2,537A energy and the killing of bacteria floating in air, whose absorption is negligible, or in water, whose absorption is variable and may be considerable. If the bacteria on a square foot of surface are dispersed in a cubic foot of air immediately behind it and given the same lethal exposure, they are killed at the same rate as on the surface, and the same amount of ultraviolet rays, unabsorbed by either air or bacteria, can produce the same killing in as many successive cubic foot volumes as it can pass uniformly through. When the ultraviolet energy is radiated from practical point or line sources the intensity may decrease, usually inversely with the square of the distance, in which case the time to produce a lethal or a complete exposure varies directly with the square of the distance, as does also the volume of the irradiated air. For this reason the final total bacteria killing done by any arbitrary amount of 2,537A energy, as that from any one practical source, is directly proportional to the distance traveled before absorption in a nonreflecting surface. These generalizations will be more fully discussed in relation to air disinfection, but even there will be only introductory to the detailed papers of Wells, Luckiesh and Holladay, Rentschler, Hollaender and others listed in the footnotes.

Sources of Ultraviolet Energy

Three different types of ultraviolet sources are now of interest to the medical profession and are certified by the Council on Physical Medicine of the American Medical Association. They are, in chronologic order of acceptance, quartz mercury arcs, sun lamps and bactericidal lamps. Discussion of their electrical characteristics is outside the scope of this paper, but a comparison of their radiation characteristics may be of value as indicative of the extent to which each type of source may properly be used for the purposes for which the others were developed.

Therapeutic Quartz Lamps. — Quartz lamps⁷ such as are used for medical

7. Johnson, L. B., and Webster, S. B.: Important Improvements in Fused-Quartz Mercury Arcs, *Rev. Scient. Instruments* 9:325 (Oct.) 1938.

purposes and for water disinfection and milk vitaminization are rated at 250 to 2,000 watts in the arc tube, which is fused quartz glass operated nearly red hot in places and at about the boiling temperature of mercury in the coldest parts to provide an internal pressure of about 1 atmosphere. The emitted ultraviolet energy is in lines of various intensity and spread through the full ultraviolet range from 3,800 \AA to 2,000 \AA . As plotted in figure 4A,

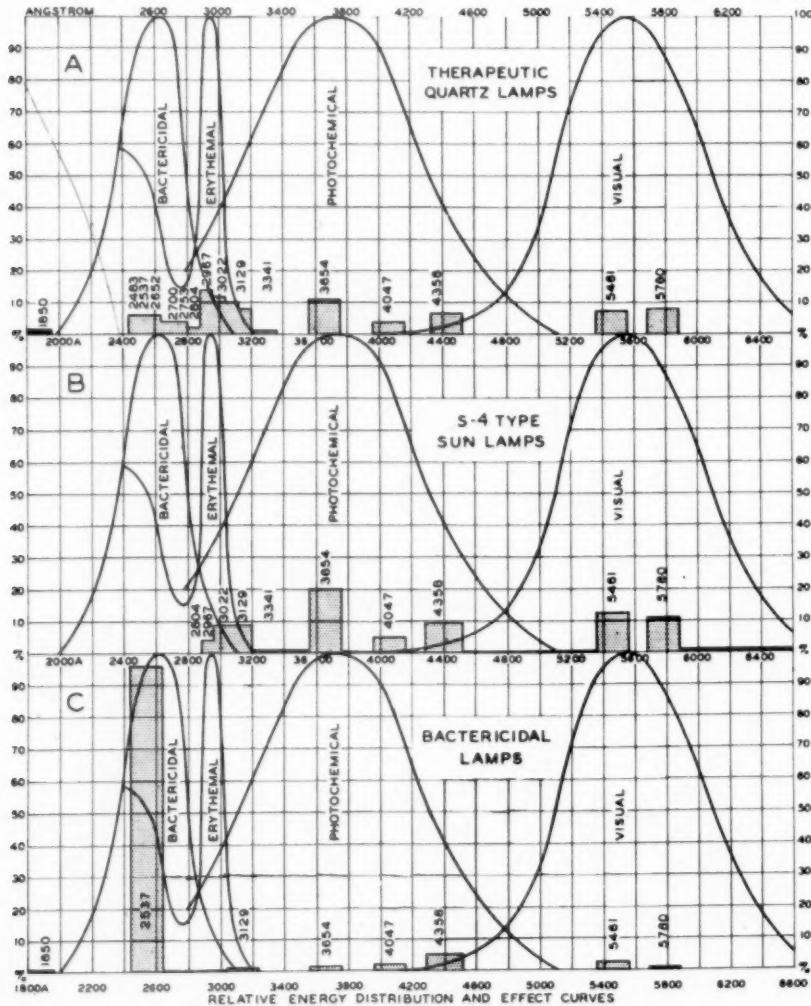


Fig. 4. — Relative energy distribution for equal electrical inputs to therapeutic, sun and bactericidal lamps with superimposed effect curves.

line areas are proportional to the total of energy of each wavelength emitted per 100 watts of energy into the arc. The data are typical of the lower wattage types but of no one unit.

Sun Lamps. — Sun lamps of the type accepted by the American Medical Association and most extensively sold⁸ are rated at 100 watts in the arc, which is a small quartz mercury arc similar to the therapeutic lamps, enclosed in a special bulb to prevent emission of any energy of a wavelength less than 2,800 \AA and not found in sunlight. The emitted ultraviolet rays

8. Barnes, B. T.; Forsythe, W. E., and Karash, W. J.: Spectral Distribution of Radiation from Lamps of Various Types, Gen. Elect. Rev. 42:540 (Dec.) 1939.

of longer wavelength than 2,800A are similar in nature to those from a therapeutic mercury arc but of much less intensity under comparable conditions. As plotted in figure 4B, the line areas are proportional to the total watts of energy emitted per hundred watts into the arc.

Bactericidal Lamps. — Bactericidal lamps⁹ are rated at 4 to 30 watts in the tube, which is of a special pyrex type of glass operated so relatively cold that it can be held in the hands and at an internal pressure about one hundred thousandth (0.00001) the pressure of the quartz mercury arc. In great contrast with that of quartz lamps, the spectrum of the bactericidal lamp is, for practical purposes, of but one line, at 2,537A, the so-called resonance line of mercury, which is practically absorbed in the higher pressure areas. Of the total ultraviolet rays, less than 5 per cent are of other wavelengths, as is indicated in figure 4C, where the areas are proportional to the total watts of energy emitted per hundred watts of input to the arc. The data are typical of commercially available bactericidal lamps but of no one unit.

Therapeutic, Sun and Bactericidal Lamp Spectrums. — The various effect curves shown on figure 4 indicate graphically the application values of each of the three types of spectrum. It is interesting to note that the total ultraviolet energy per watt is about the same for the therapeutic and bactericidal lamps in spite of the remarkable difference in the relative energy distribution of their spectrums. Therapeutic quartz lamps are obviously effective for all three uses indicated by the effect curves but have only about one-half the efficiency of production of 1,800 to 2,800A characteristic of the high wattage quartz mercury arcs used for water disinfection. The erythema effect curve is believed to be fairly representative of therapeutic value, with considerable uncertainty as to its interpretation as applied, for example, to the 2,537A line of the bactericidal lamp. Figure 4C shows graphically the coincidence between bactericidal effectiveness and the efficiency of the production of 2,537A ultraviolet energy in bactericidal lamps and their low efficiency, 3 to 4 lumens per watt, as light sources.

A discussion of the relative merits of high pressure quartz lamps and low pressure glass lamps for bactericidal applications is outside the scope of this paper, but at present the former are unsuitable for general use in air disinfection because of the cost of fused quartz glass and because of ozone formed in objectionable quantity by the 1,850A mercury line emitted by the quartz lamp. Low pressure quartz mercury lamps with filter jackets to suppress 1,850A are commercially available sources of 2,537A and are similar in their characteristics to the glass types.

All further discussion of the uses of 2,537A for air disinfection will be solely in terms of watts of energy of 2,537A, and the data will apply to any source of this energy whose output of it is known.

Ultraviolet Air Disinfection in Ducts. — An obvious experimental approach to ultraviolet air disinfection is by means of sources installed in ducts used to define the air velocity (speed and direction) and total quantity, the ultraviolet intensity and range of action. Wells⁴ and Luckiesh and Holladay⁵ have used the method most skilfully to secure data for elaborate mathematical analyses of the problem. Their data have been compared with those of Koller,⁶ Rentschler, Nagy and Mouromseff⁵ and Hollaender³ in the preparation of the following somewhat simplified analysis of duct air disinfection in

9. Thayer, R. N., and Barnes, B. T.: The Basis for High Efficiency in Fluorescent Lamps J. Optic Soc. America 29:131 (Mar.) 1939. Rentschler, H. C.: Production and Control of Bactericidal Ultraviolet Radiation, Am. A. Advancement Sc., Pub. No. 17, Aerobiology, pp. 167-170, 1942. Buttolph, L. J.: Characteristics of Some Low Voltage Type Germicidal Lamps, *ibid.* pp. 171-180. Robinson, F. W.: Practical Considerations in the Design and Maintenance of Ultraviolet Air Sanitation Equipment, *ibid.* pp. 181-183. Kruetzkamp, J.: Characteristics of Sperti, Inc. Ultraviolet Lamps, *ibid.* 184-5.

terms of the data and the concepts for figures 2 and 3. I assume all responsibility for the compromises necessary in this practical application of laboratory methods and data.

In the case of air flow through a duct containing sources of 2,537A, the time and intensity factors of the disinfecting lethal exposure are defined by the minutes of air travel through the irradiated zone and by the average intensity of the ultraviolet energy throughout the zone. It is convenient to consider the ultraviolet energy as uniformly concentrated in 1 foot of length of the duct, so that the time of air exposure to the energy becomes minutes per foot (the reciprocal of its speed in feet per minute). The exposure data of figure 3 may then be extended to this condition of extremely short ex-

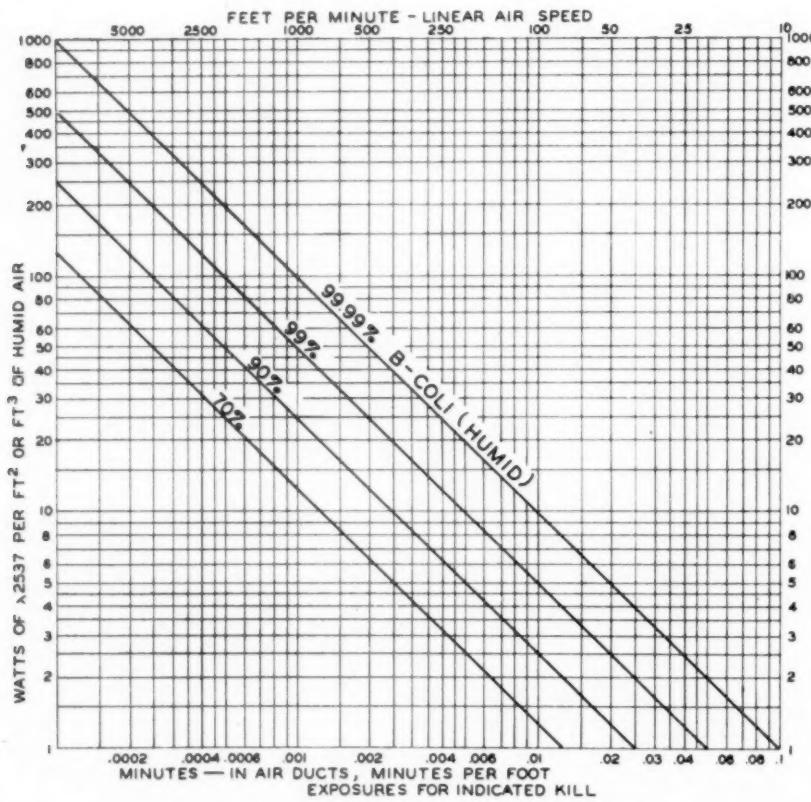


Fig. 5. — Bactericidal exposures in terms of duct dimensions and air speeds.

posures to high intensities, as in figure 5, which is only an extension of figure 3 from its upper left corner.

If we assume any convenient duct cross section and air speed, 1 square foot and 1,000 feet per minute (0.001 of a minute per foot), for example, we find from figure 5 that at 0.001 minute per foot an intensity of 50 watts per cubic foot will provide a 99 per cent kill. At the 1,000 cubic feet per minute (C. F. M.) of our example, this is 20 C. F. M. per watt of ultraviolet energy. Similarly, the C. F. M. per watt of 2,537A for various air speeds and various percentages of kill may be read and calculated from figure 5. It is important to note, however, that these data on watts per cubic feet refer only to intensity in space and that another fundamental factor must be considered before the source watts necessary to produce the indicated intensity can be determined.

Because the absorption of 2,537A energy by air, by bacteria or by any ordinary contamination is negligible, the output of a source is effective in producing lethal intensities in as many successive cubic feet as it can pass

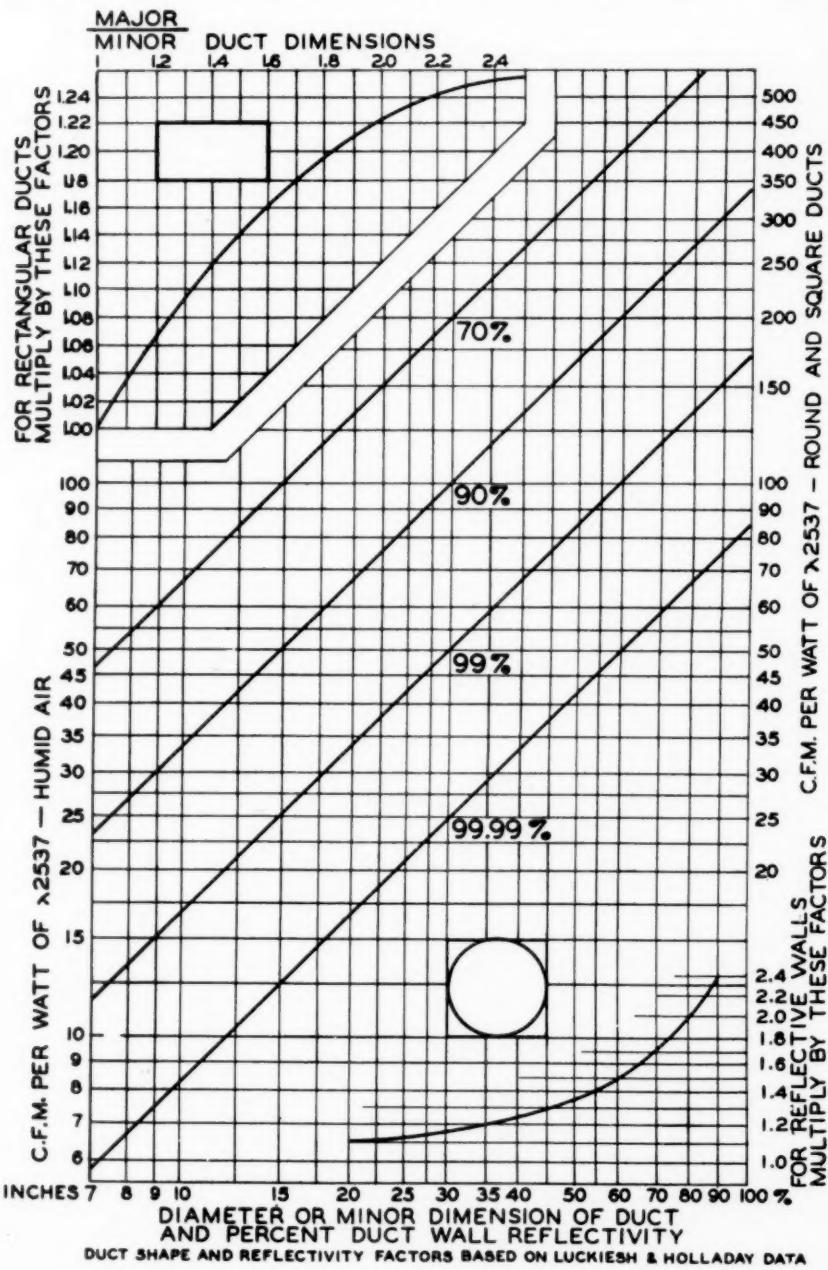


Fig. 6. — Work chart for calculating the ultraviolet requirements for duct air disinfection.

through before absorption. This is best illustrated in the case of a parallel beam of sunlight which provides a certain intensity per cubic foot along each successive foot of its direction until absorbed by a nonreflecting surface. It can be shown by a rather complicated analysis that the bactericidal effec-

tiveness of divergent ultraviolet rays from a bactericidal lamp is directly proportional to the distance from the source to an absorbing surface. On this basis the C. F. M. per watt calculated from the data of figure 5 may be related to various duct sizes, as in figure 6. From this figure alone and without reference to any other charts or tables, the number of bactericidal lamps required to provide typical degrees of kill in air ducts of various sizes, shapes and air speeds may be calculated.

The basic duct ratings in C. F. M. per watt of 2,537A must be adjusted in individual cases by adding the increased effectiveness due to ultraviolet rays reflected from the duct walls (as indicated by the graph at the lower right of figure 6) and by adding the increased effectiveness due to the major dimension of rectangular ducts according to the inserted graph (Luckiesh and Holladay⁵). For example, with a 24 by 36 inch duct with 50 per cent reflective walls and an air speed of 600 feet per minute, the total C. F. M. would be 3,600 and a 99 per cent kill would be produced in 42 by 1.35 by 1.14, or 65 C. F. M. per watt of 2,537A from ultraviolet sources. A total of 55 watts of 2,537A would therefore be required, and it could be provided by means of eight of the largest available bactericidal lamps.

Figure 5 indicates, further, that an extreme depreciation of 40 per cent in the lamps and a total loss of duct wall reflectivity would still provide a 90 per cent kill, as would one half as many lamps initially. Double the number of lamps would provide an initial kill of 99.99 per cent and a minimum under extreme depreciation of 99 per cent. Figure 6 is based on conditions of high humidity, and figure 3 indicates that of usual winter conditions of 30 to 50 per cent relative humidity, eight lamps would still provide a 99 per cent kill after extreme depreciation.

Transition from Duct to Room. — The air-disinfecting efficiency of an ultraviolet source varies directly with the size of the duct in which it is installed, as indicated in figure 6. This suggests placing the source directly in the room served by a duct system, since such a room may be considered as an enlargement of the duct itself. The practical limitation to this is that in occupied rooms intensities effective for rapid bacteria killing are irritating to the face and eyes and the ultraviolet radiation must be confined to the space above approximately a 7 foot level. Such a method may be thought of as a two stage process in which intensive irradiation above a 7 foot level provides a reservoir of germ-free air which, in turn, serves to disinfect or dilute the contamination of the lower air as if by ordinary ventilation interchange or circulation of air.

Upper Air Irradiation. — Wells¹⁰ has accurately analyzed the upper air problem by integrating the various distances and intensities for typical ultraviolet sources and has correlated air circulation with actual measurements of the bacterial concentration in the upper and lower air levels. He worked with *B. coli* sprayed into the air to permit an accuracy in air sampling difficult to secure when one is working only with naturally occurring bacterial contamination. Luckiesh and Holladay¹¹ have applied to the problem the results of their accurate measurements in ducts by considering a room as if it were divided by a partial horizontal diaphragm, in the plane of the ultraviolet sources, into upper and lower horizontal ducts in series, with air speeds in them inverse as their cross section.

This paper tentatively proposes a slight modification of the duct analogy by considering a room as a vertical duct with a continuous vertical inter-

10. Wells, W. F.: Sanitary Ventilation, Heating, Piping & Air Conditioning **14**:143 (Feb.) 1942; Air Disinfection in Ventilation, *ibid.* **16**:363 (June) 1944. (The second reference contains a very full bibliography.)

11. Luckiesh, M., and Holladay, L. L.: Designing Installations of Germicidal Lamps for Occupied Rooms, *Gen. Elect. Rev.* **45**:343 (June) 1942.

change of air such that there is upward, but not necessarily localized, air movement through one half the horizontal cross section of the room and a corresponding downward movement through the other half, a duct whose minor dimension determines the spatial effectiveness of the ultraviolet source,

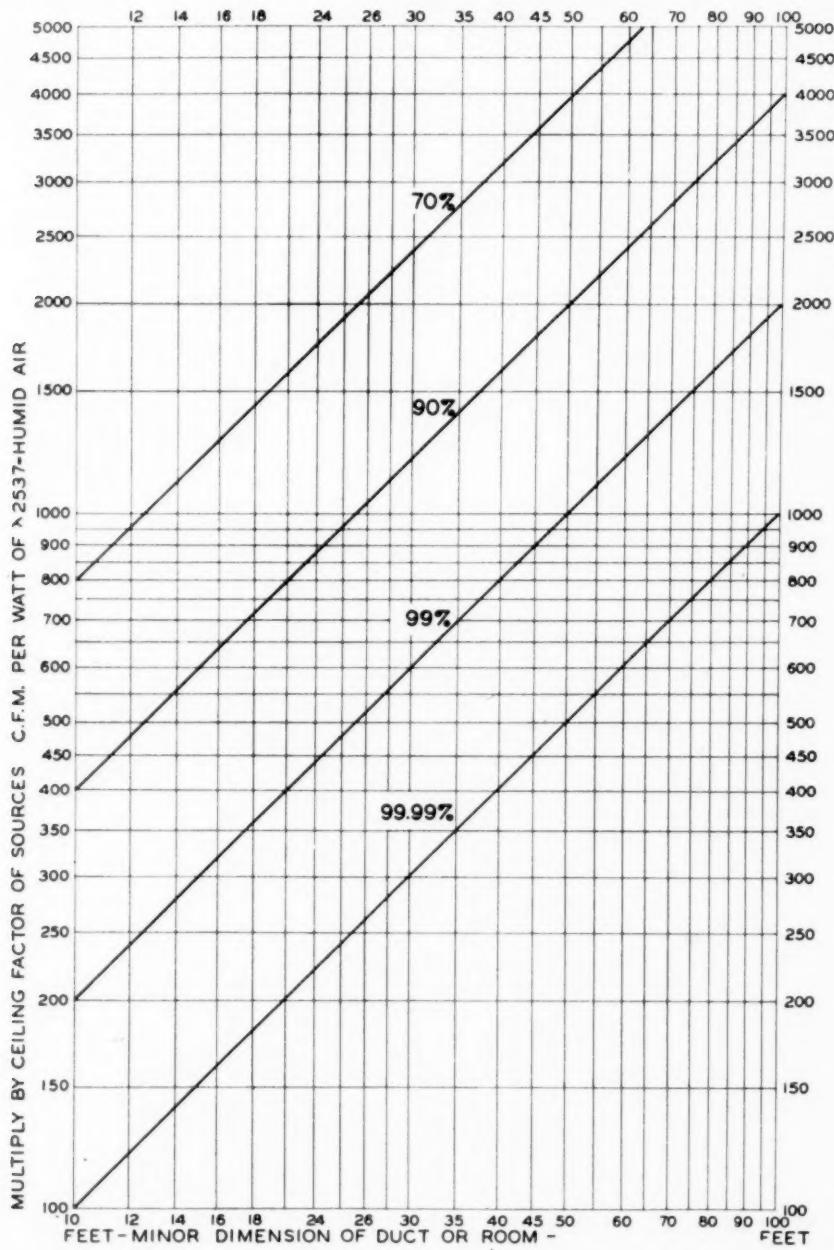


Fig. 7. — Work chart for calculating ultraviolet requirements for room air disinfection.

as in an ordinary duct, and in which the distance from the fixture plane to the ceiling is related to empiric factors covering the energy distribution characteristics of various fixtures. The air movement is rated in effective feet per minute and, multiplied into one half the horizontal cross section

of the room (floor or ceiling area), provides the actual air circulation in C. F. M., as in a duct.

Figure 7 extends the duct data of figure 6 to the larger cross sections and the slower air speeds characteristic of room conditions and may be used for practical work in a similar way. For example, assume a school room 22 by 32 feet with a 12 foot ceiling and with side wall bactericidal fixtures mounted at a level 7 feet from the floor or, more significantly, 5 feet from the ceiling, with a ceiling factor of 0.5. Assume the air interchange to be at 20 feet per minute, through one half the room cross section in the plane of the fixtures, and the total air movement in the room becomes 7040 C. F. M. For a minor dimension of 22 feet, figure 7 indicates the C. F. M. per watt to be 425 for a 99 per cent kill. This multiplied by the ceiling factor and divided into 7,040 calls for a total of 33 watts of 2,537A energy. Assume an output of 7.2 watts of 2,537A from the bactericidal lamp used and the number of such lamps required becomes at once 33 divided by 7.2, or about four such lamps and fixtures mounted 5 feet from the ceiling.

Lower-Air Disinfection. — As has already been suggested, the upper air method of disinfection may be considered as a two stage process in which air disinfection to any necessary degree may be readily obtained and from which disinfection of the lower air is secured by air interchange, by natural or forced air movement or by a combination of the two. The amount of lower air disinfection thus obtained is fully defined by the air circulation characteristic of the individual room and may be illustrated by a continuation of the previous example. The total volume of the room below the 7 feet level is 4,928 cubic feet, and into it moves 7,040 cubic feet of air per minute, providing the effect of 1.42 air changes per minute, or 85 air changes per hour. This provides a disinfection of the lower air of 85 lethes per hour, which is considered equivalent to the natural ventilation secured by opening most of the windows, as is possible only in the summer and impractical then because of drafts. It may properly be compared with the disinfection by dilution of 8 to 10 lethes per hour in those few cases in which the conventional 30 cubic feet of fresh air per minute per child is provided through a ventilating system. The ineffectiveness of a ventilation of eight lethes per hour is illustrated by the fact that it takes an hour to disinfect a room completely after it has been vacated and there is no continuing infection of the air. Eighty-five lethes per hour will, in contrast, completely disinfect the air of such a room, a hospital ward between occupancies, for example, in five to six minutes.

Sanitary Ventilation. — Although percentages of bacteria killing by ultra-violet energy or of disposal by ventilation have been emphasized in this paper as providing a physical basis for air disinfection, it is important to remember that direct sampling of pathogenic bacteria from infected air is very difficult and that the correlations between respiratory disease and the concentration of bacteria are largely unknown. The certain thing is that outdoor air, and indoor ventilation providing an equivalent low bacterial concentration, reduces the spread of respiratory infection. Lethes, as well as percentage kills, are convenient indexes of sanitary ventilation and provide a way of comparing it with the much lesser amounts of ordinary ventilation now thought sufficient for control of dust, odor and carbon dioxide.

ARCHIVES of PHYSICAL THERAPY

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

∴ EDITORIALS ∴

PHYSICAL MEDICINE AND PSYCHIATRY

The large number of casualties reported in the armed services because of neuropsychiatric disorders emphasizes once more the magnitude and importance of this medical problem. Physical therapeutic measures have for years been used extensively in mental hospitals with beneficial effects, particularly continuous tub baths and other more elaborate hydrotherapeutic procedures. Although something is known of the effect of these agents on peripheral circulation, for the most part their use is based on empiricism, especially in the major psychoses. Electric shock therapy has introduced a new interrelation between psychiatry and physical medicine and possibilities for mutual research endeavors lend hope for the discovery of some fundamental knowledge of value in both specialties.

In psychosomatic medicine is found an excellent opportunity for the combined activities of the internist or surgeon, psychiatrist and physical medicine specialist in both treatment and investigative work. The illnesses studied in this field are those in which there exists a pathologic lesion in addition to a psychic factor. The gastrointestinal diseases are foremost examples of the relation of symptoms to various types of situational and emotional stimuli.¹ In experimental work on patients with peptic ulcer, anxiety and other emotional states have been known to alter the gastric acidity, volume of secretion and peristaltic activity.² Similar studies involving the use of massage, heat and hydrotherapy would be of interest. Psychosomatic studies on mucous colitis, constipation, spasm of the colon and ulcerative colitis have also been reported which suggest a disorder of the colon brought about by parasympathetic nervous system activity.³ The effects of physical therapy on such activity could be investigated with profit. In connection with psychotherapy in the treatment of ulcerative colitis Lindemann⁴ has brought out the value of properly guided occupational therapy which is another aspect of physical medicine again closely allied to psychiatry. In many patients with rheumatoid arthritis important psychologic factors may be discovered which influence the course of the disease. As physical therapy plays such an important role in the management of this condition there is an opportunity to combine it with psychotherapy as the intimate contact of physical treatment, especially massage, often produces a favorable atmosphere. Emotional components have been reported in a large percentage of asthma cases. Breathing exercises are often beneficial in this condition and this effect may be partly explained by the resultant general relaxation which is known to be produced by breathing technics. Muscular tension as measured by grip pressure during handwriting has been found to be abnormally high in psychiatric patients.⁵ Further studies along this line would be valuable as many physical therapeutic procedures are aimed at reduction of muscular tone.

1. Vorhaus, M. G., and Orgel, S. Z.: Psychomatic Relationship to Gastrointestinal Diseases, *J. A. M. A.* **126**:225 (Sept. 23) 1944.

2. Mittelmann, B.; Wolff, H. G., and Scharf, M. P.: Emotions and Gastroduodenal Function; Experimental Studies on Patients with Gastritis, Duodenitis and Peptic Ulcer, *Psychosom. Med.* **4**:5 (Jan.) 1942.

3. White, B. V.; Cobb, S., and Jones, C. M.: Mucous Colitis; a Psychological Medical Study of Sixty Cases, *Psychosom. Med. Monograph I*, Washington, D. C., National Research Council, 1939, p. 1.

4. Lindemann, E.: Unpublished Data.

5. Ruesch, J., and Finesinger, J. E.: Muscular Tension in Psychiatric Patients, *Arch. Neurol. & Psychiat.* **50**:439 (Oct.) 1943.

In a number of basic research problems physical medicine and psychiatry may work hand in hand. An example of this is found in a study of the psychologic and somatic aspects of pain and the effects of physical agents. Cooperative research in these two specialties might also be carried out in the important problem of fatigue as occurs in combat and in industry as well as in psychoneurotic patients. It is to be hoped that the psychiatric aspects of physical medicine will be recognized and fostered in the plans for development of the specialty.

NEW THERAPY FOR POLIOMYELITIS

In the constant hope of improving the results of treatment in poliomyelitis new agents and methods are tried. An example of this is found in a preliminary report of blood ultraviolet irradiation.¹ Because of the well-recognized spontaneous improvement in this disease and the great variability in cases, the effects of any type of therapy are difficult to evaluate. This is particularly true of symptoms designated as "toxic" in nature and which are not generally considered as a usual feature of infantile paralysis. Neurotripsy² represents an effort to decrease the residual paralysis by facilitating the peripheral mechanism of motor innervation. This is a type of physical treatment of great interest to those specializing in Physical Medicine. Although first reports are encouraging, long term studies by a variety of observers will be necessary before these methods can be finally evaluated and recognized as permanent additions to physical medicine.

1. Miley, G. D.: Ultraviolet Blood Irradiation Therapy in Acute Poliomyelitis. Preliminary Report on 58 Consecutive Cases, *Arch. Phys. Therapy* 25:651 (Nov.) 1944.

2. McFarland, J. W.; Billig, M. E.; Taylor, G. M., and Dail, C. W.: Kenny Treatment Combined with Neurotripsy in Care of Poliomyelitis, *Arch. Phys. Therapy* 25:645 (Nov.) 1944.

POST-WAR EDUCATION IN PHYSICAL MEDICINE

Plans for postgraduate education are of vital importance in the future development of physical medicine. This fact has already been emphasized in the report of the Baruch Committee on Physical Medicine where it is stated that the first of the chief needs for proper development is an adequate supply of physicians who can teach and use physical medicine. It has also been pointed out that the preeminent need is for teachers. At the present time there are not enough qualified instructors in this field to handle the anticipated needs of expansion. New men must be found and trained in this specialty and the most likely source of manpower is in the recent medical graduate who at present is probably in federal service. It is accordingly gratifying to note interest in post-war education in physical medicine among medical officers in the Army, Navy and Public Health Service. The results of a questionnaire survey answered by one thousand officers selected at random in all theatres of operation indicated that 79.6 per cent desired some full time educational training.¹ On the basis of the requests for house officerships received it has been estimated that the total number of requests from all medical officers for residencies or fellowships in physical medicine will amount to sixty as compared with the normal pre-war number of five. Although the number of additional facilities required would be reduced to thirty if demobilization extends over a two-year period, this represents a six hundred per cent increase. The accuracy of these figures can not be relied on because of the relatively small number of men interested in this specialty, but the possibility of an important post-war problem in education

1. Johnson, V., and Arestad, F. H.: Educational Facilities Required for Returning Medical Officers, *J. A. M. A.* 126:253 (Sept. 23) 1944.

can not be denied. This problem is further complicated by the great need for basic and clinical research in the field. The duration of the training period will amount to about three years to properly train new leaders in the field. Fortunately through the support of grants from Mr. Baruch, fellowship programs have already been worked out in a number of university medical centers. The challenge to resourcefulness, energy and vision has been anticipated and it seems justified to say "At last the long delayed development of physical medicine seems at hand."²

^{2.} Krusen, F. H.: The Future of Physical Medicine with Special Reference to the Recommendations of the Baruch Committee on Physical Medicine, *J. A. M. A.* 125:1093 (Aug. 19) 1944.

MEDICAL NEWS

Baruch Fellowships in Physical Medicine Harvard Medical School

The Harvard Medical School announces fellowships in Physical Medicine supported by grants from the Baruch Committee on Physical Medicine.

The purpose of these fellowships is to provide a three year training for academic and clinical careers in the field of Physical Medicine. These fellowships are granted annually but subject to renewal for a total duration of three years. The first year will be wholly or in part devoted to basic research related to Physical Medicine in one of the pre-clinical sciences such as physiology, anatomy or biophysics. The second year will be spent in clinical training in Physical Medicine at the Massachusetts General Hospital and other hospitals affiliated with the Harvard Medical School. In the third year fellows will be assistants in Physical Medicine with clinical responsibilities. For candidates with extensive previous training, one year clinical fellowships will also be granted.

Applicants must have an M.D. degree from an approved medical school and a minimum of one year of internship in an approved hospital.

The annual stipend will be \$2500 (single), \$3000 (married).

Applications may be obtained from the Dean, Harvard Medical School, 25 Shattuck Street, Boston 15, Massachusetts.

Physicians Attend Hearing of Federal Communications Commission

At the scheduled hearing of the Federal Communications Commission, the Council on Physical Medicine of the American Medical Association was represented by Dr. H. B. Williams of New York City and Dr. Emil J. C. Hildenbrand of Washington, D. C.

As reported in the October issue of the ARCHIVES, Dr. William H. Schmidt of Philadelphia represented the American Congress of Physical Medicine and the Society of Physical Medicine.

These physicians discussed the value of medical and surgical diathermy as it applies to the practice of medicine.

Dr. Elkins Takes Part In Panel Discussion

At the twenty-second annual meeting of the National Society for Crippled Children, which was held in Chicago, October 30 through November 1, Dr. Earl C. Elkins, Section on Physical Medicine, Mayo Clinic, Rochester, Minn., participated in one of the panel discussions and discussed the activities of the Baruch Committee on Physical Medicine.

Col. Smith Post Surgeon

Lieut. Col. Euclid M. Smith, M.C., is post surgeon at the Pampa Army Air Field, Pampa, Texas. Col. Smith is Secretary of the Southern Section of the American Congress of Physical Medicine.

Capt. Pruce Speaks on Wartime Medical Program

A special session on physical medicine was held recently at Stark General Hospital Medical Library. The speakers included Lieut. Col. Charles H. Fair, M.C.; Major John G. Reid, M.C.; Capt. Arthur M. Pruce, M.C., on "Physical Medicine and War Injuries," and Lieut. Elizabeth Kelly, P.T.A., and Captain Pruce on "Peripheral Nerve Injury: The Role of Splinting and Physical Therapy in Preoperative and Postoperative Care," a demonstration.

Dr. MacEachern Lectures at the University of Chicago

Dr. Malcolm T. MacEachern, associate director of the American College of Surgeons, lectured at the University of Chicago School of Medicine, September 27, under the auspices of the Nu chapter of Alpha Kappa Kappa. His subject was "Postgraduate Medical Education."

Graduation at D. T. Watson

Preliminary commencement exercises were held October 6th, at Sunny Hill, Leetsdale, Pa., for the graduation class of the D. T. Watson School of Physical Therapy. The program follows:

Selection—"First Call" - Galbraith Dodster
 Entrance of Class
 Lieutenant Elizabeth A. Dean
 Commanding Officer
 Women's Army Corps Detachment
 National Anthem
 Invocation
 The Reverend Doctor Henry R. Browne
 Shields Presbyterian Church
 Remarks
 Mr. Francis R. Harbison
 Representing the D. T. Watson Board of Directors
 Selection—"Prelude" - - Rachmaninoff
 Miss Margaret E. Rae
 Address
 Colonel Cleon J. Gentzkow
 Commanding Officer
 Deshon General Hospital
 Selection—"Caprice" - - - Brahms
 Miss Margaret E. Rae
 Message for the Class
 Miss Kathryn Kelley
 Chief Instructor and Technical Director
 D. T. Watson School of Physical Therapy
 Presentation of Provisional Diplomas
 Major Florence M. K. Murray
 Director of Women's Army Corps at the
 Third Service Command
 Baltimore, Maryland
 Selection—"Preludes" - - - - Delius
 Miss Margaret E. Rae

Federal-State Program of Vocational Rehabilitation

More details of the expanded vocational rehabilitation program under the Federal Security Agency, recently initiated by Congress in amendments to the Vocational Act (Public Law 113, 78th Congress) have been made known. They provide for federal aid to enable state boards of vocational education and state agencies for the blind to furnish disabled persons with all services necessary to render them employable or more advantageously employable. These services include medical and surgical care, hospitalization, physical and occupational therapy, prosthetic appliances, vocational counseling and training, maintenance during training, occupational tools and

equipment, placement in employment and other necessary services.

Mentally as well as physically disabled persons are now eligible for rehabilitation. Except for certain groups of war disabled civilians and federal employees injured in line of duty, persons receiving physical restoration services or maintenance grants must be in financial need. (It was emphasized that rehabilitation of veterans with service connected disabilities is conducted through the separate program under the U. S. Veterans Administration.)

Convalescent Hospitals

The Surgeon General has planned to meet the overflow load in general hospitals and to provide for the treatment of lone-time evacuee cases by the establishment of convalescent hospitals and the following have been or are about to be established: Lovell General Hospital, Fort Devens, Massachusetts; England General Hospital, Atlantic City, New Jersey; Fort Story, Virginia; Welch Convalescent Hospital, Daytona Beach, Florida; Wakeman General Hospital, Camp Atterbury, Indiana; Brooke General Hospital, Fort Sam Houston, Texas; Percy Jones General Hospital, Battle Creek, Michigan; Camp Carson, Colorado Springs, Colorado; and Mitchell Convalescent Hospital, Camp Lockett, California. Later, convalescent hospitals will be opened at Fort Lewis, Washington, Camp Butner, North Carolina and possibly in other places.

The program at a convalescent hospital will include: (1) physical reconditioning, calisthenics, remedial exercises, road and track work and athletics; (2) occupational therapy; (3) educational activities, including orientation and information classes, typewriting, shorthand and business courses; (4) recreational activities.

Office Vocational Rehabilitation

Dr. Victor H. Vogel, Surgeon, U. S. Public Health Service and Dr. Mark E. Gann, Surgeon, (R), U. S. Public Health Service have joined the staff of the Office of Vocational Rehabilitation, Federal Security Agency, according to an announcement made by Michael J. Shortley, Director of the Agency.

As Consultant in Psychiatry, Dr. Vogel's activities will include organization of programs for the rehabilitation of persons with psychiatric disabilities as well as mental hygiene programs for all handicapped. Dr. Gann has been assigned as Assistant Regional Representative to the western area to supervise physical restoration services and to interpret the rehabilitation program to co-operating organizations and professional groups.

Rehabilitation for Tuberculosis

Potts Memorial Institute, one of the oldest rehabilitation facilities for the tuberculous in the United States, formally opened its school of business on September 29, 1944.

Professional Advancement Expedited by Polio Treatment Scholarships

The need for properly qualified orthopedic nurses and trained physical therapists, strikingly acute during the epidemic of this past summer, might have been greater had not the National Foundation granted over \$163,500 during the past four years for scholarships to prepare them for the expert handling of infantile paralysis outbreaks.

Although the results are far from fulfilling the needs, with scholarships still available for eligible women, a total of one hundred and twelve women have been or soon will be added to the rolls of nursing specialists, teachers of nursing and physical therapists. In addition, many National Foundation Chapters, on their own, have sponsored the training of hundreds of local candidates to build up the reserve of these vital workers, should infantile paralysis strike in their own communities.

Thirty-three scholarships to date have been given by The National Organization for Public Health Nursing, twenty-two by The National League of Nursing Education and sixty-seven by The American Physiotherapy Association, all through funds supplied under Foundation grants.

The NOPHN has been administering scholarships the longest of the three—since 1940. Twenty-four of its trainees have completed their studies and are working in the field. Fourteen of them now hold supervisory teaching positions, where they are able to pass on their specialized knowledge and skills to students, thus further increasing the numbers of trained workers; two hold staff orthopedic positions, four are obtaining supervised experience on salary, two are in the Army, one resigned because of illness and one is doing substitute work until internship experience becomes available.

Of the twenty-two trained by NLNE scholarships, dating back to 1941, seven today are in orthopedic clinics, wards and hospitals; five are teaching, one is an industrial nurse, one is in the Army, one in the Navy and seven still are studying.

The problem in awarding all these scholarships is in finding women with proper prerequisite training to insure that they will benefit by additional study, and thus be more useful to their communities and to the nation. Not everybody can be a nursing specialist. Most of the women who have been aided in their education in this field have had relatively wide experience before they applied for the scholarships. It is the belief of the National Foundation that, by placing new tools into already-skilled hands a larger measure of protection is given patients suffering from infantile paralysis and from other afflictions requiring this kind of nursing and care.

The search for qualified applicants for scholarships can be expedited only if the purpose of the scholarships and the prerequisites for their award are understood. A glance at the backgrounds of some of the women who already have received scholarships may help to identify those who might apply.

NOPHN scholarships were given to supervisors of various city and state crippled children's services, associations for aid of crippled children, orthopedic visiting nurses; to public health nurses of county and city health departments; to instructors in health education; to senior staff nurses. In each instance the scholarship was made on the applicant's merits and the likelihood of her broadening her activities in the community or the nation.

One orthopedic nursing supervisor, herself a former polio patient, in addition to her regular work undertook to train twenty-five nurses' aides in the Kenny treatment of polio, after she had completed her own scholarship work. Two such aides, working as a team, can care for five or six patients. They work on convalescents only, never during the acute stages of the disease, and always under the guidance of trained nurses.

The women who received NLNE scholarships to help prepare them for teaching positions in schools of nursing, were orthopedic nurses and supervisors, surgical supervisors, nursing arts instructors, and head nurses at various hospitals. One of the latter, formerly a surgical supervisor at a New England hospital, now is supervising clinical practice of 1944 scholarship students at another New England hospital. Many of the 1943-44 scholarship recipients will return to their own hospitals as orthopedic supervisors when their studies are complete.

Qualifications for those seeking physical therapy scholarships are graduation from an accredited school of nursing or possession of a B.S., B.E., or B.A. degree, including 26 hours of science. This latter requirement has been modified to include qualified undergraduates who have had a minimum of two years of college with adequate science courses. The women now in training have been teachers, nurses, research workers, laboratory technicians, research assistants and physical education instructors.

The 1944 epidemic of infantile paralysis has officially become the second worst in the recorded history of the disease in the United States, it was announced by Basil O'Connor, President of The National Foundation for Infantile Paralysis.

At the same time, Mr. O'Connor stressed the need for more skilled polio fighters, especially physical therapists, and urged that men and women who have the proper qualifications make applications for scholarships offered by the National Foundation and its chapters.

In the first 41 weeks of 1944, or up until Oct. 14, there were 16,133 cases of poliomyelitis. The all-time record was in 1916 when there were 27,621 cases.

"This great outbreak has tested not only the resources of The National Foundation and its Chapters, but also those of the nation," he added. "The National Foundation's greatest problems were in obtaining sufficient physicians, physical therapists and professional personnel to cope with nearly simultaneous outbreaks in widely separated sections of the south, the east and the middle west. Seven skilled polio physicians, 65 physical

therapists and nearly 10 tons of wool for use in hot pack treatments were rushed to stricken areas by The National Foundation. All 26 respirators owned by The National Foundation are still in use in epidemic areas. At the request of The National Foundation, the American Red Cross recruited more than 700 nurses from all parts of the country to staff regular and emergency hospitals."

The seven states most severely menaced were New York, North Carolina, Pennsylvania, New Jersey, Virginia, Ohio and Kentucky, but emergency aid has been sent to 21 states and the District of Columbia.

"Although The National Foundation and its Chapters have trained many physical therapists in the modern principles of treating infantile paralysis, many more technicians are still needed for this present fight," said Mr. O'Connor. "The greatest handicap in rendering effective aid in any epidemic of infantile paralysis has been the lack of physical therapists. The National Foundation for Infantile Paralysis through its scholarships in accredited schools of physical therapy has been and still is seeking to enlarge this first line of defense.

"These scholarships sponsored by The National Foundation are available to graduate nurses, graduates in physical education or those with a minimum of two years undergraduate college work with science courses. Such applications may be made through The National Foundation or to The American Physiotherapy Association, 1790 Broadway, New York 19, N. Y.

"The field of physical medicine is expanding rapidly and this is an opportunity for men and women to enter an interesting, lucrative profession with a chance of performing a humane service."

Publications Available

The National Council on Rehabilitation is now offering copies of the *Symposium on the Processes of Rehabilitation* from the program presented on May 25, 1944, at the National Conference of Social Work in Cleveland, Ohio, under the auspices of the Council. These pamphlets are 5c a copy and may be obtained on request from the office of the Council, 1790 Broadway, New York 19, N. Y.

Organizing to Help the Handicapped, The Farthest Corner and Organizing for the Handicapped are publications now available and can be obtained by writing to the National Society for Crippled Children, Inc., Elyria, Ohio.

The American Heart Association, Inc., has announced the publication of several new pamphlets: *Occupations for Those with Heart Disease; Problems in the Prevention and Relief of Diseases of the Heart; Diseases of the Arteries, Their Significance, Recognition and Treatment; High Blood Pressure (Hypertension); Diseases of the Veins; Heart Disease Caused by Coronary Arteriosclerosis and Heart Disease in School Life.*

These pamphlets may be obtained from the American Heart Association, Inc., 1790 Broadway, New York 19, N. Y., at 5c per copy.

Community Services for Veterans: A Guide for Planning and Coordination, published by the National Committee on Service to Veterans under the auspices of the National Social Work Council, may now be secured for 10 cents each; orders of more than 100 copies, 5 cents plus postage.

Music Therapy

A new experiment has been inaugurated in the Psychiatry Department at St. Luke's Hospital, Chicago, where recreational therapy is being expanded to include music and drama. The experiment with music therapy is the first of its kind in Chicago and broadens the field of diversional, or recreational therapy which is receiving more and more attention in medical circles.

In drama therapy, plays are selected which have meaning in terms of the conflict presented in the play which is similar to the conflict in the patient's life.

University of Maryland Honors General Kirk

Major General Norman T. Kirk, U. S. A., the Surgeon General of the Army, recently received the honorary degree of Doctor of Science from his alma mater, the University of Maryland, at Baltimore, Md. The citation was read by Major General Robert U. Patterson, Dean of the Medical School and former Surgeon General of the Army. Governor Herbert R. O'Conor of Maryland placed the hood on General Kirk and made the presentation. General Kirk then addressed the graduates of the Schools of Medicine and Nursing and presented their diplomas. Prior to the ceremonies, Dr. Bird, President of the University of Maryland, and members of the faculty of the Medical School gave a dinner in honor of General Kirk at the Hotel Belvedere.

General Kirk Talks on Discharged Casualties

The American public should be told the truth about what war does to its fighting men, Major General Norman T. Kirk, U. S. A., Surgeon General of the Army, told the New York Times Conference recently. He described the different types of war casualties who are no longer "fit for duty" but are being fitted by reconditioning to return to civilian life. When these men leave the Army hospital, said General Kirk, they are ready to face the world. But when they become the subject of misplaced public sympathy or morbid curiosity the work of months can be undone in minutes. In conclusion he urged that the public help these disabled veterans along the road to success and happiness by giving intelligent understanding to their problems and treating them as the normal human beings they are.

First Physical Therapist Awarded Legion of Merit

First Lieutenant Metta L. Baxter, P.T., of Los Angeles, now stationed with the 21st General Hospital in Italy, is the first physical therapist to be awarded the Legion of Merit. Her citation reads "for exceptionally meritorious conduct in the performance of outstanding service." Lieutenant Baxter is a graduate of Kansas State College, Manhattan, and received her physical therapist certificate from the Army Medical Center, Washington, D. C.

General Hume Awarded Oak Leaf Cluster to Distinguished Service Medal

At a ceremony commemorating the landing of American troops at Salerno, Lieutenant General Mark V. Clark presented Brigadier General Edgar Erskine Hume, U. S. A., with the Oak Leaf Cluster to the Distinguished Service Medal in recognition of his highly successful administration of the City of Naples. General Hume, who is Chief of Allied Military Government for the Fifth Army in Italy was formerly Public Relations Officer of the Medical Field Training School, Carlisle Barracks, Pa. He has been awarded four other decorations within the past few months—the Bronze Star, the Grand Cross of the Order of the Crown of Italy, the Silver Medal for Military Valor of Italy and the French Croix de Guerre.

Lieutenant Major Honored by Italian Government

First Lieutenant Ralph H. Major, Jr., MC, of Kansas City, Mo., aide de camp to General Hume in Italy and former Editor of "The Medical Soldier," has been awarded the Cross of War for Military Valor by the Italian Government.

Reconditioning Program Broadened

Reconditioning, which was acclaimed before the recent meeting of the District of Columbia Medical Society as being as significant in its field as the sulfa and penicillin drugs, has made marked strides in the past few months according to a

report submitted by the Surgeon General's Reconditioning Consultants Division to the Baruch Committee.

The program has been extended to the Southwest Pacific, the European Theater, Hawaii and Greenland, with highly favorable results. Soon a program will be inaugurated on hospital ships so that the returning sick and wounded will have the benefit en route of personnel trained in physical and educational reconditioning.

The Army's reconditioning program is regarded as an important factor in the decrease of 260 per cent in disability discharges from hospitals. Through this comparatively recent plan of organizing the convalescent phase of hospitalization the disabled soldiers are restored in a much shorter time to the highest possible efficiency. The program complements the Army's medical service by providing training along educational, physical, occupational and diversional lines.

New Rehabilitation Center Opened in Chicago

Honorable Dwight H. Green, Governor of Illinois dedicated the Veterans Rehabilitation Center, 2449 West Washington Boulevard, Chicago, Illinois, on November 3, 1944.

War-Time Graduate Medical Meetings

Dr. George Morris Piersol has been selected to fill the vacancy on the central committee caused by the death of Dr. William B. Breed. Dr. Piersol represents the American College of Physicians.

The guest speakers at the program on "Orthopedic Problems of General Interest," held at Camp Ellis, Illinois, recently were Drs. Edward L. Compere and Paul B. Magnuson.

Colonel Irving S. Wright spoke at Chanute Field, Rantoul, Illinois, on the subject of "Thrombosis, Thrombophlebitis and Anticoagulants."

Dr. Don C. Sutton spoke on "Rest" at the U. S. Naval Hospital, Great Lakes, Illinois.

A War-Time Graduate Medical Meeting was conducted at the DeWitt General Hospital. Dr. Howard C. Naffziger lectured on "Peripheral Nerve Lesions and Their Treatment," and also held a clinic centered around several patients at the hospital.



BOOK REVIEWS

CLINICS. Edited by *George Morris Piersol*, M.D., Professor of Medicine, Graduate School of Medicine, and Professor of Clinical Medicine, School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania. Vol. II, No. 5. Pp. 276. Price, \$2.00. Philadelphia: J. B. Lippincott Company, 1944.

This book consists of a symposium on war medicine containing the material presented in the Teaching Panels during the 51st Annual Meeting of the Association of Military Surgeons of the United States. Since few editorial changes were made in the material recorded by the stenotype reporters, the spontaneity of the original sessions was preserved.

The subjects presented, which are of importance to both civilian and military practice of medicine, included chemotherapy, the pharmacology and toxicology of various chemical agents, and the application and results of use of penicillin, tyrocidine, gramicidin and the sulfonamide drugs, particularly in the treatment of injuries and diseases resulting from war. Another subject of the panel was the management and prophylaxis of venereal diseases. Unfortunately a large part of the lengthy discussion of fatigue was "deleted by the censor"; however, important information was published concerning heat exhaustion, nutrition and conditioning against fatigue. Fractures, wounds, burns, plastic surgery and gastrointestinal disorders also were discussed in detail.

Several original contributions, in addition to the informal panels, are included in the book. They are "A Study of Cardio-roentgenography in Army Examinees," "Burns Incident to War—Measures for Their Prevention and Treatment," "Management of Purpura," "A Simple Walking Cast," "Effect of Shock on Intramuscular Pressures" and "Ochronosis—Report of a Case with Alkaptonuria and Melanuria."

This small paper-backed volume presents interesting and valuable opinions, and therefore it should be worth-while reading for both the physician in general practice and in the service.

MEN OF SCIENCE IN AMERICA. THE ROLE OF SCIENCE IN THE GROWTH OF OUR COUNTRY. By *Bernard Jaffe*. With a foreword by *George Sarton*, Associate of the Carnegie Institution, Professor in Harvard University. Cloth. Pp. 600 with 53 illustrations. Price, \$3.75. New York: Simon & Schuster, 1944.

This book is a selection of The Scientific Book Club. In it the author paints a broad picture of the growth of science in the United States. The story is told in terms of the lives and achievements of the scientists themselves. It starts with

Master Thomas Harriot, who came here in 1588 with Raleigh's expedition, and who, in addition to his investigations in the fields of mathematics and astronomy, was the first press agent for the newly-discovered American tobacco. It ends with the accounts of Edwin Powell Hubble, astronomer and Ernest Orlando Lawrence, nuclear physicist, our contemporary explorers who, with the aid of giant engineering devices, chart the heavens and probe the secrets of the atom.

But Bernard Jaffe gives us more than a series of separate biographies. He views science and scientists against their historical background, stressing wherever possible, the influence which scientific discoveries have had on the development of our social structure, and, conversely, the influence which historical, political and social events have had on scientific development in this country.

There is real drama in the long story of America's contribution to domestic and world science. There is the stirring story of William T. G. Morton's gift of anesthesia to the world when the most eminent surgeons and medical research men of Europe had given it up as an impossibility; there is the breath-taking hunt of Othniel Charles Marsh for the huge dinosaurs of the great West which had just been opened up to paleontologists by the transcontinental railroad. In the biography of Louis J. R. Agassiz, the author relates of the coming of Darwinism to the United States in 1859. How it was one of the most curious incidents in the history of science that in this momentous battle, Louis Agassiz placed himself squarely on the side of the anti-Darwinians. At first he called the theory "mischievous." Later his opposition took on a stronger tone. "My recent studies," he wrote in 1867, "have made me more adverse to the new scientific doctrines which are flourishing now in England. This sensational zeal reminds me of what I experienced as a young man in Germany, when the physio-philosophy of Oken had invaded every center of scientific activity; and yet, what is there left of it? I trust to outlive this mania also."

The author continues: "Agassiz' colleague at Harvard, James Russell Lowell, sided with the scientist. 'Such a mush (evolution) seems to me a poor substitute for the Rock of Ages,' was his remark. He added, 'I am a conservative—with God against evolution.' It was not difficult to understand Lowell's outburst. The Cambridge Brahmin hated science. 'I hate it as a savage hates writing,' he once said, 'because I fear it will hurt me somehow.' But for Agassiz to stick to his guns to the last with the assertion, 'There is no evidence of a direct descent of later from earlier species'—that was something else again. The great Agassiz, who could with one broad

sweep *see* a glacial icecap crawl over the face of the earth and produce the widespread effects of the glacial era, was as blind as a bat to the hypothesis of Darwin. The brilliant Agassiz, who for many years had studied the striking changes wrought by nature in the fossils from ancient seas, could see no passage of one fish into another among the 1,500 species of extinct fish. He would not admit that his work had actually illuminated the whole evolutionary process among the fishes, nor would be admit its connection with the new story which Darwin had unfolded in its entirety for the first time."

In this connection Jaffe continues that this impact of the revolutionary theory of evolution on the Negro problem was interesting. A Harvard professor of anatomy wrote, "It cannot be denied that the Negro and the orang do afford points where men and the brute, when the totality of their organization is considered, most nearly approach each other." This statement was taken up by proponents of slavery as proof that the black man was below the white man in the scale of life and hence a fit slave for the superior white man.

These and other tales are told for the layman in language which is neither over-scientific nor over-simplified. The book clearly shows the record of America's achievements in science stands up favorably with the achievements of the scientific centers of Europe. It should destroy, among other notions, the popularly-held belief that America has made great strides in technology and invention, but has offered little in the field of pure and theoretical science.

This volume is worth reading because it gives an interesting and comprehensive treatment of American science.

HISTORY OF GYNECOLOGY. By *Richard A. Leonardo*, M.D., Ch.M., F.I.C.S., Fellow Royal Society of Medicine (London); Fellow American Medical Association; Fellow International College of Surgeons; Associate Fellow National Gastroenterological Association; Member American Association of the History of Medicine; Member History of Science Society; Member American Medical Association of Vienna (Austria); formerly President American Medical Association of Budapest (Hungary). Forewords by *Prof. J. P. Greenhill* (Loyola University) and *Prof. Victor Robinson* (Temple University). Cloth. Price, \$3.00. New York: Froben Press, 1944.

Dr. Leonardo who produced last year a history of surgery, has in the present volume brought out the first separate history of gynecology in the English language. Since much of Dr. Leonardo's work is being done in gynecology and gynecologic surgery, he is especially well qualified to present and review the program of gynecology through the ages. The sections of the ancient aspects include gynecology among the Egyptians, the Hebrews, the Hindus and the Greeks; the Alexandrian era, the Roman era and the Byzantine period are next covered; there are

chapters on gynecology in the Renaissance, and during the 17th, 18th and 19th centuries; a review of gynecologic anatomy, a chapter on the history of the vaginal speculum, and an extended study of operative gynecology wherein the history is given of each of the various major gynecologic operations. The work concludes with a survey of the recent advances in gynecology. The well-selected bibliography and the index add to the value of the volume. Twenty-five full page illustrations add to the vividness of presentation. It is unfortunate that not all physicians are interested in medical history, for its study not only presents the proper background and a broad conception of the present day methods, but also offers real fascination in reading of the work and life of the early pioneers and of their contemporaries. It is to be hoped that Dr. Leonardo's latest book will be profitably read by many physicians.

MANUAL OF MILITARY NEUROPSYCHIATRY. Edited by *Harry C. Solomon*, M.D., Professor of Psychiatry, Harvard Medical School, Medical Director at the Boston Psychopathic Hospital, and *Paul I. Yakovlev*, M.D., Clinical Director, Walter E. Fernald State School, Instructor in Neurology at the Harvard Medical School. Cloth. Price, \$6.00. Pp. 764. Philadelphia: W. B. Saunders Company, 1944.

This manual is intended to serve as a practical, convenient reference text for clinical use primarily by medical officers with little previous training in neuropsychiatry. There has been a real need for such a book which has now been satisfied by this authoritative work. There are forty-five different contributors of recognized ability.

Following introductory chapters of historical interest methods of psychiatric and neurologic examination of inductees are described together with some figures relative to cause of rejection and the success of this screening. Problems of military administration and disposition are next considered and some actual experiences with neuro-psychiatric casualties in the Army, Navy and Merchant Marine are related. A section is then devoted to clinical description of all common psychopathologic clinical entities with emphasis on those most commonly found in the armed services. Common neuromedical conditions are also discussed including peripheral nerve, spinal cord and crano-cerebral injuries. The chapters on prophylaxis and therapy deal with problems of psychology and morale, emergency care of neuroses, group psychotherapy, rehabilitation and occupational therapy. The instructions for non-medical personnel on handling psychiatric patients and practical psychotherapy for inexperienced medical officers is especially commended. In the final section special topics of wartime interest are dealt with such as neuropsychiatric disorders in the tropics and in convoy and torpedo casualties; and physiologic hazards of flying. Valuable information on cerebrospinal fluid abnormalities and

electroencephalography is found in the concluding chapters.

In spite of the large number of contributors there is little repetition and quite uniform clarity and conciseness in style. Indexing, printing and size are all well adapted for use as a practical manual. This text is highly recommended as a valuable guide for medical officers and a convenient reference for the civilian physician as well.

YOUR EYES. By *Sidney A. Fox*, A.B., Sc.M. (Ophth.), M.D., Instructor in Ophthalmology, New York University College of Medicine. Cloth. Price, \$2.75. Pp. 191, with illustrations. New York: Alfred A. Knopf, 1944.

This is a highly informative book on the established modern knowledge about the eyes and much that relates to color and sight. The first four chapters describe the optics of sight with the help of a few good illustrations. The successive eleven chapters present such ancillary topics as color-perception, including color-blindness; the effect of age on normal vision; the utility of sunglasses; the definition of good artificial lighting; the optical problems connected with motorized traffic; and the qualifications of the optometrist as compared with the optician or ophthalmologist. The author is implacable against every species of quackery, every unproved system of optical wonder-working. This authoritative and unusually well written book should be read profitably not only by intelligent laymen but also by most physicians and nurses.

NEUROLOGY OF THE EYE, EAR, NOSE AND THROAT. By *E. A. Spiegel*, M.D., Professor of Experimental Neurology and Head of Department, Temple University School of Medicine, and *I. Sommer*, M. D., Lecturer in Ophthalmology, Long Island College of Medicine; Consultant Ophthalmologist and Otolaryngologist, Chicago Eye and Ear Hospital. Price, \$7.50. Pp. 690. 118 illustrations. New York: Grune and Stratton, Inc., 1944.

This book should prove of real service to the ophthalmologist and to the laryngologist. It provides an outline of the nervous disorders associated with and complicating eye and ear diseases, as well as a concrete guide in diagnosis and treatment. Part I covers the neurology of the ear; Part II, the neurology of the eye. Part III considers the neurology of the nose, mouth, pharynx and larynx, while Part IV discusses the local symptoms of the brain stem and the cerebrum. For the student and practitioner there is much to be gained in reviewing the known facts con-

cerning the non-acoustic or statokinetic labyrinth. There is valuable information also in the section dealing with lesions of the nervous system related to aural conditions. The ophthalmologist will appreciate the part dealing with the eye fundus in diseases of the nervous system and the ear, since the significance of eye ground examinations often has to be weighed in diagnostic studies. Rhinogenic endocranial complications embrace a rather large field and this subject is always of interest to the rhinolaryngologist. The knowledge in these allied fields has attained a certain status. It is well that the specialist should have a familiarity with this knowledge. The book is profusely illustrated and will serve a useful purpose for study or reference by the otolaryngologist, but the neurologist and the internist especially interested in diagnosis can gain much by perusal of this book. There is in it a wealth of material, condensed, correlated and well classified by authors who have spent their careers in investigation of a difficult field.

PRINCIPLES AND PRACTICE OF SURGERY. By *W. Wayne Babcock*, M.D., F.A.C.S., Emeritus Professor of Surgery, Temple University, Philadelphia. With the collaboration of thirty-seven members of the faculty of Temple University. Pp. 1331, 1141 engravings and 8 colored plates. Cloth. Price, \$12. Philadelphia: Lea & Febiger, 1944.

Dr. Babcock with his usual energy has developed, with a well-qualified group of collaborators, an outstanding textbook on surgery which is up-to-date and presents in lucid fashion the newer as well as the tried surgical procedures.

The book is divided into four parts: general surgery, surgical technic, the surgery of systems and regional surgery. The excellent bibliography is listed by chapters at the end of the book and a complete index is provided.

Treatment is described in careful detail. Newer retention devices for fractures are discussed fully. Special attention is devoted to the modern treatment of burns. Careful consideration is given to abdominal and thoracic surgery and to the subject of orthopedic surgery. There are an excellent section on anesthesiology and complete discussions of the subjects of preoperative and postoperative treatment and resuscitation. Besides the rarer surgical conditions often omitted or merely mentioned in surgical texts, the common surgical conditions, operations, techniques, the special instruments, drugs, chemicals, sutures, drains, and dressings employed by the surgeon are all described fully.

Babcock's new "Principles and practice of surgery" bids fair to lead the field. It can be recommended in the highest terms.

PHYSICAL THERAPY ABSTRACTS

Effectiveness of Ultraviolet Irradiation of Upper Air for the Control of Bacterial Air Contamination in Sleeping Quarters. R. Schneiter; A. Hollaender; B. H. Caminita; R. W. Kolb; H. F. Fraser; H. G. DuBuy; P. A. Neal, and H. B. Rosenblum.

Am. J. Hyg. 40:153 (Sept.) 1944.

During the period from July 1st, 1941 to July, 1st, 1943, an investigation was carried out on the effectiveness of upper air ultraviolet irradiation for the control of air-borne microorganisms and air-borne infections in the sleeping quarters of 4 dormitories at the National Training School for Boys, Washington, D. C. Ventilation depended on the opening or closing of windows.

Two of the dormitories were equipped with ultraviolet sources for upper air irradiation and the remaining two dormitories served as controls. A total of 90,000 milliwatts of 2537A radiation was provided in each irradiated dormitory for eighteen months of the study. The radiation at bed level was found to vary from 0.5 to 3.0 ergs per cm^2 per second when all lights were clean and in operation. Therefore, it may be said that at no time did the intensity of ultraviolet radiation at bed level exceed 5 ergs per cm^2 per second.

Bacteriologic studies were made at monthly intervals. Nasal swab cultures were taken from 10 boys in each of the 4 dormitories each time that studies were made in order to ascertain the predominating type of nasal flora of the inmates. Air samples were taken with the bottle device and by the exposed plate method at two locations in each dormitory, once in the early evening and twice in the early morning. Intermediate air sample counts were obtained during the early evening from 9:30 to 10:30 P. M. soon after the inmates had retired, the lowest counts in the early morning at 5:15 to 6:15 A. M. after an extended period of quiet, and the highest counts from 6:15 to 7:15 A. M. during cleaning and bedmaking operations, or during the period of maximum human activity. The air-sample counts were thus roughly proportional to the activity within each dormitory at the time of sampling.

A bacteriologic examination was made on samples of floor dust collected in each dormitory. The incidence of microorganisms in the samples of floor dust was higher in the spring and summer months than in the fall and winter months. There was no consistent correlation between incidence of viable microorganisms in floor dust samples and in air samples collected during cleaning and bed-making operations.

The data obtained during this investigation indicate that ultraviolet irradiation of the upper air of sleeping quarters effected a reduction in the numbers of viable microorganisms in the air, and, to a lesser degree, in floor dust.

The incidence of air-borne diseases, as judged by hospital admission records, in nonirradiated and irradiated dormitories showed no significant difference under the conditions of this experiment. The variation among the dormitories was so great that no statement can be made concerning the influence of ultraviolet light on the incidence of air-borne infection insofar as these experiments are concerned.

Distribution of Vitamin A in Tissue as Visualized by Fluorescence Microscopy. Hans Popper.

Physiol. Rev. 24:221 (Apr.) 1944.

Attempts to localize biologically active substances in tissues by histochemical and histophysical methods have been carried out repeatedly in order to clarify their role in the organism. The demonstration of vitamin A by a histologic method seems to be important.

The fluorescence of vitamin A in ultraviolet light has been used for its demonstration in tissues.

The microscopic visualization of vitamin A by fluorescence permits the study of its distribution in organs. In various physiologic and pathologic conditions the distribution undergoes characteristic changes, not indicated by chemical analysis or bio-assay. Conclusions as to the role of vitamin A in the body can be made which are not arrived at by other methods. The histologic method which permits only a rough but quick estimation as to the quantity of vitamin A present, does not substitute for the chemical analysis but supplements it. The fluorescence microscopic demonstration of vitamin A not only aids in the investigation of the vitamin A metabolism but also presents a new histologic method for the differentiation of lipids independent of the biologic significance of the fluorescence.

Evaluation of Fitness. Henry Longstreet Taylor, and Josef Brozek.

Federation Proc. 3:220 (Sept.) 1944.

One of the goals of rehabilitation is to return the patient to his work in good condition. Measures instituted during convalescence to achieve more rapidly this goal must be assessed by objective criteria. The physiologist and the psychologist can provide tools which will give some objective evidence of the returning fitness of the convalescent.

The term "fitness" is generally used to cover two distinct fields. One deals with estimation of occupational work capacity, the other has for its goal the assessment of the ability to withstand physical and biological stresses. These

fields overlap and are frequently confused. Tests of cardiovascular, respiratory and metabolic processes, motor performance, sensory and intellective functions, and emotional state are reviewed to give a rounded picture of fitness of a general character which is not closely related to a specific occupation.

All fitness tests are extremely nonspecific and should always be interpreted in the light of clinical observations. No attempt has been made to review the problem with reference to particular disease entities.

At the Fitzsimons General Hospital, Denver, observations are made of the physical performance of convalescents during their activity program. In addition, repeated measurements of physical and motor fitness are made and postural examinations are also carried out in order to obtain a comprehensive picture of the progress of convalescence.

Bone Metabolism. Wallace D. Armstrong.

Federation Proc. 3:202 (Sept.) 1944.

A résumé of all knowledge of bone metabolism which might conceivably have some bearing on problems of convalescence, entirely aside from its burdensome length, would be difficult to prepare on account of the numerous disagreements in the literature. Furthermore, many of the investigations have given results which are applicable only in special and restricted circumstances or refer to conditions which can be produced only in animals under experimental conditions. If, on the other hand, the discussion were confined to matters of proven clinical usefulness, only a limited set of indefinite recommendations could be offered. The only useful function which this review can serve is to describe the needs for further explorations in this field and to indicate, in some cases, the methods by which the information might be sought. An attempt will be made to treat in some degree general metabolic consequences of fractures, factors influencing fracture healing and disuse atrophy of the skeleton.

Cuthbertson has also investigated the influence of massage and passive movements of the injured limb on the nitrogen excretion of both adult and young fracture patients. Four persons aged thirty-four to fifty-nine years received such treatments applied daily for twenty minute periods beginning relatively late in the period of convalescence (18th to 46th day following the fracture). The daily nitrogen excretion was reduced by 0.55 to 2.62 Gr. beginning almost immediately following the institution of the physical therapy measures. It is not clear what the nitrogen balance of these patients was at the time the treatments were started. However, in the case of normal uninjured adults no such effect, produced by massage, on nitrogen excretion was observed. It can, therefore, be presumed that the results obtained by Cuthbertson with the fracture cases were in some way associated with the metabolic state of these persons or that the measures of physical therapy used influenced nitrogen reten-

tion in the injured limb. Some indication was also obtained that an increased retention of sulphur and phosphorus resulted from massage and passive movement of an injured limb.

Theoretical and Experimental Aspects of Surgical Refrigeration. Frederick M. Allen.

Canad. M. A. J. 51:225 (Sept.) 1944.

The reaction when any part of a warm-blooded animal is exposed to cold is both complex and variable according to many modifications of degree and kind. The well-known vasoconstriction with pallor gives way to vasodilation, and the chilled part is apt to be bright pink from this cause and from the high oxygen content of the blood. Increased vascular permeability, with passage of fluid into the tissues, is regarded as a defensive process reducing the thermal conductivity of the tissues, and in extreme form it is a factor in the edema found in frostbite and immersion foot.

The effects of a tourniquet depend on the material, breadth, tension, time and temperature. Hard or inelastic materials, such as wire, cord, fabric or stiff rubber, create troubles either by looseness or by crushing of tissue. Breadth adds to the area of compressed tissue without reducing the degree of tension necessary for stopping blood flow. For these reasons use two superimposed turns of a $\frac{1}{2}$ inch soft rubber tube, until an ideal air-pressure instrument may be found. The tension should theoretically be the minimum which will positively stop circulation. In practice, errors are usually on the side of insufficient tension. The strong tension which is necessary in the leg seems to cause no harm, even in advanced arteriosclerosis. Paralysis is more easily produced in the arm, and padding may be helpful to prevent direct crushing of the principal nerves against bone. The limbs of animals and apparently also of human beings can survive twelve to fifteen hours of complete asphyxia at ordinary room temperatures.

Refrigeration with a tourniquet has mainly been used and is most familiar as an anaesthetic for amputations in the poor risk patient.

Reconditioning Notes.

Bull. U. S. Army M. Dept. 81:30 (Oct.) 1944.

Men with psychiatric disturbances will participate in carefully organized convalescent activities under the guidance of psychiatrists. Patients are permitted sufficient latitude to pursue interests that will be useful in later Army careers or civilian life. They wear duty uniforms instead of hospital garb and they are under military discipline. The schedules include physical reconditioning and occupational, educational and recreational therapy. Any patient who has a remote chance of being salvaged for additional military service is given a trial in reconditioning.

Should a soldier be disqualified for further military service, the reconditioning program must provide for his return to civilian life, conditioned

to the optimum state of physical fitness, well oriented and indoctrinated in the duties of citizenship.

Physical reconditioning is the process aimed at the prevention of physiologic retrogression during convalescence and directed toward the restoration of full strength and stamina through participation in progressively graded physical activities.

Educational reconditioning is the process of exciting, stimulating, and activating the mind through education, orientation, and information, thereby encouraging a mental attitude conducive to health and normal activity.

Occupational therapy is that form of treatment characterized by assignment to purposeful physical tasks prescribed for restoration of function to injured or diseased muscles, tendons, nerves and joints, for emotional instability, or prescribed as diversional activity.

Rehabilitation of the Injured in This War and the Last. H. A. T. Fairbank.

Lancet 6309:134 (July 29) 1944.

Active and passive movements for eliminating friction and gravity by suspending the limb to be exercised for "auto-assisted movements," the sound limb being made to exercise the damaged one; for exercise against graduated resistance. The auto-assisted movements differ from passive movements in that they are completely under the control of the patient.

In this war the lighter forms of handicraft are much more generally favored, and the heavier types, except carpentering and gardening, are less often provided. Useful though selected occupations are in overcoming stiffness of joints, they rarely induce a full range of movement; consequently suitable exercises are always required. Heavy work in shops is largely replaced by vigorous physical therapy, competitive games and such activities as lifting heavy logs and chopping wood. In some hospitals ancillary treatment is so thorough and complete that many service cases on discharge return direct to duty, or require little hardening in a convalescent depot to restore them to the physical fitness essential in the soldier.

In fractures of the femoral shaft early movement of the knee joint is encouraged by many surgeons. This has been facilitated by the use of skeletal traction.

Most surgeons believe that manipulation is seldom useful for restoring movement to stiff joints following fractures; as a rule they prefer to rely on active exercises and occupational therapy. The error of forcibly manipulating a stiff knee when the cause of the limited movement is binding of the quadriceps to the femur at the site of a fracture is now appreciated.

Artificial Respiration. The Need for a Greatly Increased Rate in Asphyxia. P. R. Tingley.

Brit. M. J. 4367:367 (Sept. 16) 1944.

In every method the present rate is slow. Four

seconds is a long time when applied to one respiratory cycle. In most methods it has been necessary to include a pause of one to two seconds in each cycle in order to keep the rate down to normal. In Schafer's method the interval is at the end of inspiration; in Eve's it is at the end of expiration.

In Schafer's method it is difficult to occupy fully even three seconds with the actual movements necessary for one cycle.

Silvester's method, because of the nature of the movements necessary, takes more time to perform than Schafer's, and a rate of about 45 times a minute would seem to be the efficient maximum.

The respiratory requirements are so great in all cases of asphyxia which require artificial respiration that, in such cases, the adoption in all methods of as fast a rate as possible, consistent with efficiency, must result in the quicker resuscitation of the patient.

A New Neurosurgical Instrument. A Combined Suction and Electrocoagulation Tip. Henry T. Wycis.

Am. J. Surg. 67:139 (Oct.) 1944.

The instrument was designed to coagulate bleeding points quickly and effectively. The cavity must be sucked dry to locate the bleeding point which is then grasped with a bayonet forceps. The operator then usually asks the assistant to touch the forceps with the electrocoagulation tip.

The instrument presented combines suction and electrocoagulation so that the operator, with a single hand, can carry out the maneuver. Obviously, this releases one of the valuable hands of the assistant. With suction on the bleeding point, the vessel can be sucked up into the opening of the tip, rendering the field dry. Simultaneously, the foot switch allows the electrocoagulating current to coagulate the vessel drawn up into the suction tip opening. Should this be undesirable, the instrument may be simply touched to the bayonet forceps, which can be used to grasp the vessel in a dry field.

Reconditioning of Medical Patients.

Army M. Bull. 79:23 (Aug.) 1944.

A well-conducted and long-continued experiment at Jefferson Barracks, in St. Louis, by Lieut. Colonel Rusk and Captain Erickson, on cases of atypical pneumonia has provided clear-cut evidence of the value of exercise programs in the reconditioning of these patients. There were two series of these patients distributed in alternate groups. One group was permitted to stay around the hospital with very little attempt at reconditioning, just as has usually been the practice in civilian life. The other group, which may be called the experimental group, was started on gentle exercise after the sedimentation rate had reached 10 mm. in thirty minutes. The exercise was then very rapidly increased in severity from day to day. The non-exercise group remained

in the hospital an average of forty-five days and after going back to duty exhibited a 30 per cent relapse. The experimental group which went through the reconditioning program spent an average of thirty days in the hospital with a relapse rate of only 3 per cent.

Ultraviolet Irradiation Relative to Anoxia and Bend Susceptibility. William M. Davidson.

U. S. Naval M. Bull. 43:38 (July) 1944.

Nine runs were made on 6 persons as to their anoxic response. On 7 (77 per cent) of the runs, improvement was noted. No decrease from the normal was observed. Twenty-eight runs were made on persons with relation to their known susceptibility to the bends. On 24 runs (85 per cent) marked improvement was noted. There was definitely decreased susceptibility in the remainder. The effect seems to last about three weeks.

Program for Rehabilitation.

J. A. M. A. 125:1213 (Aug. 26) 1944.

Vonachen, medical director of the Caterpillar Tractor Company of Peoria, Ill., points out that this company realized about eighteen months ago that some of its thousands of employees now in service would return with physical handicaps. A survey was made in which each supervisor listed the jobs in his department which could be performed by employees with the handicaps listed on survey cards. With this information the personnel division, with its knowledge of "job analysis," was ready to interview the individuals and then present the applicant to the medical division for its approval of the specific job chosen. A personal interview followed, impressing on the employee the necessity for care and safety in his work. Many of the employees with physical handicaps are attending special classes given by a training school in order that they may advance in their quest of independence. This program has been successful, for the vast majority of these people have a production, safety and absentee record above normal. They are paid the same rate as normal persons; they are shown no special favors and are in no way considered as accepting charity. In Caterpillar's handicapped group are only those with the loss of one or both extremities, pronounced deformities, loss of one or both eyes, loss of hearing and speech, and those with healed tuberculosis, heart disease and the like. At present Caterpillar has approximately 800 such handicapped employees, and this number is remarkable when consideration is given to the fact that it builds heavy machinery. After Caterpillar assured itself of the success of this program in its plant, it felt that the plan should be carried forward to the community. The idea was offered to the Peoria Manufacturing Association, and from this came "The Peoria Plan for Human Rehabilitation—Civilian and Military," which is believed to be the first to be established in a community with a complete working organization.

Rheumatism and the Menopause. Francis Bach.

Brit. J. Phys. Med. 7:88 (May-June) 1944.

The clinical picture of chronic gout may closely resemble the rheumatoid and osteoarthritic types of arthritis. It is the sick person who must be treated rather than the process. Thyroid extract in the form of dry thyroid, $\frac{1}{2}$ grain twice a day, is of value when there is no evidence of hypertension.

Stimulation of the pelvic organs and increase of the blood supply, possibly to the ovary itself, by means of intrapelvic diathermy, with a belt and vaginal electrode, or application of short wave therapy to the pelvic area twice a week for a period of from four to six weeks is of value.

Attention to the feet, for example removal of corns on the plantar or dorsal area of the toes, or the provision of suitable shoes with instep supports, metatarsal pads or straight inner sided shoes, with the heels raised on the inner side and prolonged forwards may be advisable. Physical measures applied to the feet in the form of faradic foot baths or flat foot exercises are important.

To improve the general circulation in those patients who are obese and have a raised blood pressure, aeration baths, carbon dioxide foam, brine and pine baths, general massage and general light treatment may be given.

In the treatment of localized panniculitis, histamine, ionization and ultrashort wave therapy are of undoubted value. If flexion deformity of the knees and partial subluxation have appeared, careful manipulation of the affected joints and the use of plaster of Paris casts should be undertaken.

The Scalenus Anticus Syndrome. Roy L. Swank, and Fiorindo A. Simeone.

Arch. Neurol. & Psychiat. 51:442 (May) 1944.

The cases of 15 patients with a condition diagnosed as the scalenus anticus syndrome are classified into two main groups: those of a superior type due to compression of the upper roots of the brachial plexus, principally of the sixth and seventh cervical nerves, by the tendons of origin of the scalenus anticus muscle and those of an inferior type, due to compression of the lower roots of the brachial plexus, principally of the eighth cervical and the first thoracic nerve, by the same muscle near its insertion.

The mechanism of compression is thought of as a vise, the ventral jaw of which is the scalenus anticus muscle. The structure forming the dorsal jaw varies. Section of the scalenus anticus muscle removes the ventral jaw of the vise and renders the vise ineffective.

The etiologic factor in most cases seemed to be hypertrophy of the scalenus anticus muscle. Strenuous exercise and overactivity of the respiratory muscles appeared to be the most important causative factors in this hypertrophy. In a few cases the syndrome may have been precipitated by "myositis" or "myalgia."

Seven of the patients were relieved by a regimen of rest, posture and physical therapy; 8 (2 with a bilateral syndrome) were relieved by anterior scalenotomy.

High Frequency Electric Current in the Treatment of Alcoholic Hallucinosis. K. Y. Gruenberg.

Am. Rev. Soviet Med. 1:548 (Aug.) 1944.

The treatment of alcoholic hallucinosis by high frequency electric current was undertaken by way of experiment, although it was based on observations of a psychotic syndrome of other etiology. The author frequently found, especially among schizophrenic patients with auditory hallucinations that after an exposure to the high frequency current, more often, towards the end of the treatment, the voices became for a time less loud, less clear and more distant. These observations suggested the use of the same theory in cases in which the predominant syndrome is of a delusional nature, as in alcoholic hallucinosis.

As to the therapeutic action of high frequency electric current on alcoholic hallucinosis, it must be considered from the standpoint of the definite pathogenic mechanisms which have a definite function in the origin of hallucinosis and the effect of high frequency electric current on these mechanisms.

The Effect of Appropriate Electrical Stimulation on Atrophy of Denervated Skeletal Muscle in the Rat. F. S. Grodins; S. L. Osborne; F. R. Johnson; S. Arana, and A. C. Ivy.

Am. J. Physiol. 142:222 (Sept. 1) 1944.

The literature is not in agreement regarding the effect of the electrical stimulation of denervated skeletal muscle on its rate of loss of weight and strength. Some investigators have observed that the rate is retarded and others have observed either no effect or an unfavorable effect. This study was undertaken with the idea that the most appropriate electrical stimulus for degenerating muscle has not been determined and supplied, and that a type of current could be found which would produce a smooth tetanic contraction of denervated muscle without causing normal muscle to contract and without causing pain.

The electrical stimulating apparatus used in this study is a wide frequency range electronic generator with a frequency range of from 0 to 150,000 cycles per second. With it many wave forms of varying intensity may be generated.

Stimulation with 25 cycle alternating current markedly diminishes the rate of atrophy in the denervated gastronemius muscle of the rat. No such beneficial effect was demonstrated with a "slow sinusoidal" current. Some theoretical and practical aspects of electrical stimulation are discussed.

Stimulation of Denervated Skeletal Muscle With Alternating Current. F. S. Grodins; S. L. Osborne; F. R. Johnson, and A. C. Ivy.

Am. J. Physiol. 142:221 (Sept. 1) 1944.

The present study was undertaken to obtain information regarding the responses of denervated skeletal muscle to alternating current stimulation with special reference to its application in clinical electrotherapy.

According to the authors, for threshold stimulation with alternating current, denervated muscle has an optimum frequency in the neighborhood of 1 to 3 cycles per second. The optimum frequency and the slope of the intensity-frequency curve is a function of the index of response chosen to evaluate it. When the muscle is called on to do considerable work or exert considerable tension, the optimum frequency is about 25 cycles per second and the slope of the curve below this point becomes steep. The relation of these results to the interpretation of the mechanical response in denervated muscle and to practical electrotherapy is discussed.

Some Properties of Maximal and Submaximal Exercise With Reference to Physiological Variation and the Measurement of Exercise Tolerance. Craig Taylor.

Am. J. Physiol. 142:211 (Sept. 1) 1944.

Exercise experiments or tests may be classed as submaximal or maximal depending on the response they induce in the subject. The essential criterion is whether the subject is able to complete the task or is forced to quit from excessive fatigue or exhaustion. By proper selection of the intensity and duration of exercise in relation to the physical capacity of the subject, the test may be made submaximal or maximal. When it is desired to plan such tests for a fairly heterogeneous group of subjects, including extremes of high and low fitness, certain considerations apply such as the intensity and duration of submaximal exercise cannot exceed the capacities of the poorest subject, and a maximal exercise test, on the other hand, must bring all subjects to a comparable degree of exhaustion.

Thirty-one subjects were given a test twice, consisting of a four-minute walk on the treadmill and a run to exhaustion after a four-minute interim rest, the retest following in three days. Heart and respiration rates, ventilation, blood lactate, per cent oxygen and CO_2 and oxygen consumption were determined during the walk and during the last minute of the run and the first three of these measures throughout walk and run. From these data it has been possible to evaluate the sources of variation in the physiological measures and their validity as indicators of fitness.

Intra-individual variation, a prominent source of test unreliability, ranges from 10 to 58 per cent of the total variance. In general, this intra-individual variation declines in maximal as compared to submaximal work. Heart rate and blood

lactate were the most reliable submaximal measures, but are approximated in maximal work by per cent oxygen and oxygen consumption. Ventilation was of low reliability in both submaximal and maximal work, while respiration rate became highly reliable in the latter form of exercise.

Time-run in the maximal test is more reliable than any of the physiologic measures, but it is closely approached by a battery of heart rate measures including the second derivative of a cubic fit to the heart rate curve obtained during the run.

Heart-rate, ventilation, blood lactate and respiration rate at the maximal minute of the run show no significant correlation with time-run, thus indicating that all subjects tended to reach individually varying ceilings, which were unrelated to the time of running. Per cent of oxygen and CO_2 , and oxygen consumption show moderate correlation with the run. This tends to show that fitter subjects were possessed of greater circulatory reserve.

The high correlation achieved between time-run and the heart rate battery, which serves as a reliable index of adaptation to maximal exercise, particularly the later phases of this adaptation, offers great promise for the development of a practical test of exercise tolerance.

Fluorescence Microscopy: Its Value in Studying Tuberculous Tissues. Frank H. Tanner.

Nebraska M. J. 29:314 (Oct.) 1944.

A brief history of the development of fluorescence microscopy for demonstrating *Mycobacterium tuberculosis* has been given. Additional observations have been presented regarding the use of this method in tissue sections. It is suggested that the fluorescence method may be of value in studying the pattern of organisms in tissue infected by *Mycobacterium tuberculosis*.

Continuity in Rehabilitation. W. Arklay Steel.

Brit. J. Phys. Med. 7:72 (May-June) 1944.

As far as results of treatment of fractures and soft tissue lesions are concerned, injuries may be divided into two groups.

Usually there is not any difficulty or anxiety met with in approximately 80 per cent of all traumatic cases treated at a clinic. The remaining 20 per cent comprise cases of complicated or multiple fractures or both, one or more of which may or may not be compound. These may be divided into the three following sub-groups:

Patients with whom difficulties in treatment are encountered and anatomical alignment and full return of function cannot be ensured no matter what treatment may be carried out; cases in which from the beginning a bad result can be anticipated, with permanent infirmity and incapacity. This sub-group includes severe multiple injuries, with

extensive lacerated wounds, permanently destroying soft tissues and perhaps accompanied by compound fractures; cases in which the injuries have been so severe that permanent total incapacity is inevitable. The greatest difficulty is experienced with the patients in the 20 per cent group, for in these some degree of disability exists which prevents certain patients from attaining the efficiency necessary for an early return to their former occupation and in others necessitates a change of occupation. The surgeon should remain in control of treatment throughout until the patient gains a place in his old occupation or obtains alternative work in keeping with the limits of his capacity.

The light work necessary for the graded treatment of a patient is sometimes difficult to find. Often the patient who, at the surgeon's suggestion, discusses with his employer the possibilities of such work is told that none is available. It is lamentable that no niche can be found for the willing worker so that he may rehabilitate himself adequately.

Early Operation for Volkmann's Ischaemic Contracture. G. A. Pollock.

Brit. M. J. 4353:783 (June 10) 1944.

The recognition and adequate treatment of Volkmann's ischaemic contracture in its early stages will result in a good functional recovery in most cases.

In a recent standard textbook on orthopedic surgery, in a paragraph dealing with the question of operations designed to relieve intrinsic pressure on the vessels in the developing stages of Volkmann's deformity, it is stated that "as a rule damage is already irreparable when the arm is observed, and for this reason the operation is seldom applicable." Too complete an acceptance of this ruling will result in many cases progressing to ischaemic deformity which would otherwise have been prevented had the benefits of early surgery been sought.

An Analysis of Colles' Fracture. S. C. Rogers.

Brit. M. J. 4354:809 (June 17) 1944.

Reduction is checked radiographically, and graduated and vigorous, active exercises to fingers, elbow, and shoulder are started immediately under supervision. A high sling is worn for three or four days. The plaster is removed after five weeks and the exercises are intensified. The patient usually returns to light clerical work after one week (in plaster), to light manual work after seven weeks, and to heavy work after about nine weeks. He is discharged when his range of movement is approaching that of the normal side and he has been doing his usual work without complaint for at least a week.